CASIC Multimode Satellite Navigation Receiver

Protocol Specification

V4.2.0.3
2020-01-06

Documentation	
Document NameCASIC Multimode Satellite Navigation Receiver Protocol Specification	
The document summary details the CASIC multimode satellite navigation receiver protocol specification, including the common standard NMEA0183 protocol protocol, and custom binary protocols.	
Version number V4.2.0.3	
Date	2020.01.06
version update	
V3.7.0.1	2017.07.21 Modify the RXM-MEASX message to comply with the RINEX302 standard.
V3.8.0.1	2017.12.06 Expand the leap second information part (LPS) of the NMEA protocol; add NMEA-DHV and corresponding protocols for NMEA-UTC sentences.
V3.9.0.0	2017.12.20 Added support and content of NMEA-GST sentences.
V4.0.0.0	2017.12.26 Added NMEA-LPS information content. The content of some sentences has been updated.
V4.1.0.0	2018.3.26 Corrected the meaning of some signs of binary protocol content; corrected some names.
V4.2.0.0	2018.11.14 Added corresponding protocols for NMEA-INS sentences and NAV=IMUATT messages.
V4.2.0.1	2018.11.22 Corrected a typo.
V4.2.0.2	2019.05.14 Modify the NMEA-INS sentence, CFG-INS.
V4.2.0.3	2020.01.06 Added PCAS60 statement and modified PCAS03 statement.

1 NMEA protocol

1.1 NMEA Protocol Features

The CASIC receiver is compatible with the international standard NMEA0183 protocol, supports NMEA0183 version 4.1 by default, and is compatible with V2.3 And V3.X version, support NMEA0183 V4.0 standard by sending command, and standard before V2.3.

Data is transferred serially asynchronously. The first bit is the start bit, followed by the data bits. Data bits follow least significant bit first the rule of.

data transfer method

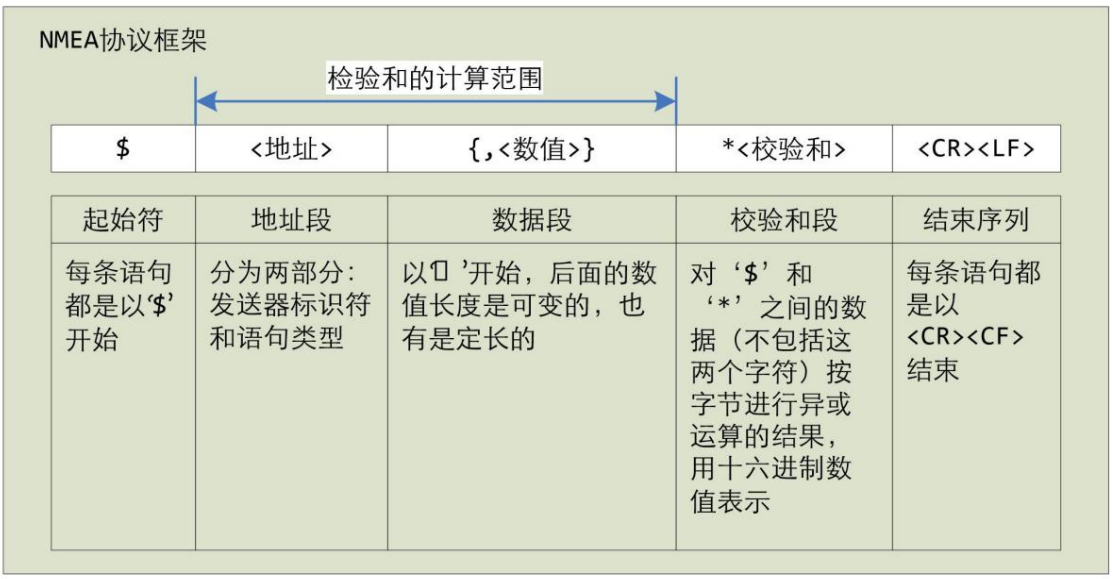
	Start bit D0 D1			D2 D3 D4	D5 D6 D7 Stop bit					

Parameters used for data transfer

Baud rate (bps) Support 4800, 9600, 19200, 38400, 57600, 115200	
data bit	8 bits
stop bit	1 person
parity bit	none

1.2 NMEA Protocol Framework

NMEA messages are sent by GNSS receivers that support the NMEA0183 protocol. Data Format Protocol Framework



Detailed NMEA protocol standard reference http://www.nmea.org/

Based on the NMEA protocol framework, this receiver protocol specification adds custom sentences to control the receiver's working mode, and query the product information of the receiver, etc. The identifier for a custom statement is 'P'.

1.3 NMEA Identifiers and Field Types

1.3.1 Transmitter Identifier

The NMEA sentences distinguish different GNSS modes by the transmitter identifier, which is defined as follows:

Transmitter	identifier
Beidou Navigation Satellite System	BD
(BDS) Global Positioning System (GPS, SBAS, QZSS)	GP
Global Navigation Satellite System (GLONASS) Global	GL
Navigation Satellite System (GNSS) Custom Information	GN
	P

1.3.2 Satellite number identifier

Satellite Number Identifier	Satellite PRN in Satellite System	NMEA Correspondence between Satellite Number and PRN	
GPS	1~32	1~32	0+PRN
SBAS	33~51	120~138	87+PRN
GLONASS 65~88		1~24	64+PRN
BDS	1~37	1~37	0+PRN
QZSS	33~37	193~197	PRN-160

1.3.3 System Identifier

The CASIC receiver supports a variety of NMEA data protocol formats, and the difference between different protocols is reflected in the system identifier.

Newer versions of the protocol add some fields.

	NMEA4.0 and below	NMEA4.1
GGA		[1] Identification
ZDA		[1] Identification
GLL		[1] Identification
RMC		[1] Identification
VTG		[1] Identification
GSA		[1] Identification, adding additional fields to distinguish different systems
GSV	[1]Identification[1]Identification[1]Identification[1]Identification	[2]Identification [2]Identification [2]Identification [2]Identification

[1] Identification: If only BD, GPS, GLONASS, Galileo and other satellites are used for position calculation, the transmission identifier is BD,

For GP, GL, GA, etc., if multiple systems are used for satellite acquisition position calculation, GN is used for the transmission identifier.

[2] Identification: GP (GPS satellite), BD (BDS satellite), GL (GLONASS satellite)

As mentioned in Section 1.1, the CASIC receiver supports three versions of the NMEA0183 protocol standard. List these three standards

The differences are as follows.

The main differences between NMEA2.2 and 2.3/4.0 are:

1) The item of positioning mode (Mode) in GLL, RMC and VTG statements is not output.

2) For the positioning quality (FS) item in the GGA statement, 1 is used for both dead reckoning and normal positioning

The calculation is set to 6).

The NMEA 4.1 protocol adds some fields based on 4.0:

1) Add a systemId item to the GSA statement.

2) Add a signalId item to the GSV statement.

3) Add a navStatus item to the RMC statement.

For details, please refer to the introduction of NMEA sentences in Section 1.5.

1.3.4 Field Type

Field Type	symbol	definition
Private Format Field		
state	A	Single character fields: A=Yes, the data is valid, the alarm flag is cleared; V=No, the data is invalid, and the alarm flag is set.
latitude	ddmm.mmmm	Fixed/variable length fields dd means degrees with a fixed length of 2, mm before the decimal point Indicates the fixed length of 2 minutes, mmmm after the decimal point indicates A variable-length fraction.
longitude	dddmm.mmmm fixed/variable length field	ddd means degrees with a fixed length of 3, The mm before the decimal point represents a fixed length of 2 minutes, the decimal point The following mmmm represents a variable-length fraction.
time	hhmmss.sss	Fixed length field hh is the hour with a fixed length of 2, mm is the fixed length 2 minutes, ss before the decimal point means a fixed length of 2 Seconds, sss after the decimal point represents fractional seconds with a fixed length of 3.
determine field		Some fields are specified for predefined constants.
value field		
Variable	xx	Variable-length or floating-point number fields
Number Fixed Hex Field hh___ Variable Hex		Fixed-length hexadecimal number with the most significant bit on the left
Field h--h Information Field		Variable-length hexadecimal number with MSB on the left
Fixed alpha field aa___ Fixed numeric field		Fixed-length uppercase or lowercase alpha character field
xx___ Variable text		Fixed-length numeric character fields
	c--c	variable-length valid character field

1.4 NMEA message overview

page message name		Class/ID	describe
NMEA standard messages			Standard message
	GGA	0x4E 0x00	receiver positioning data
	GLL	0x4E 0x01	Geographic location - latitude/longitude
	GSA	0X4E 0x02	Factor of Precision (DOP) vs. Effective Satellites
	GSV	0x4E 0x03	visible satellite
	RMC	0x4E 0x04	Recommended minimum dedicated navigation data
	VTG	0x4E 0x05	Ground speed and heading
	GST	0x4E 0x07	Statistics of receiver pseudorange errors
	ZDA	0x4E 0x08	time and date
	ANT	0x4E 0x11	Antenna Status
	LPS	0x4E 0x12	Satellite system leap second correction information
	DHV	0x4E 0x13	receiver speed information
	UTC	0x4E 0x16	Receiver Status, Leap Second Correction Simplified Information
NMEA custom message			custom message
	CAS00	-	Save configuration information
	CAS01	-	Communication protocol and serial port configuration information
	CAS02	-	Set the location update rate
	CAS03	-	Enable or disable output information and its frequency
	CAS04	-	Set the initialization system and the number of channels
	CAS05	-	Set the sender identifier of the NMEA sentence
	CAS06	-	Query module software and hardware information
	CAS10	-	Boot mode and auxiliary information configuration
	CAS12	-	Standby Mode Control
	CAS20	-	Online Upgrade Instructions

1.5 NMEA standard messages

1.5.1 GGA

Information GGA			
Data describing receiver time, location, and positioning			
type output			
Format $--GGA,UTCtime,lat,uLat,lon,uLon,FS,numSv,HDOP,msl,uMsl,sep,uSep,diffAg e,diffSta*CS<CR><LF>			
Example $GPGGA,235316.000,2959.9925,S,12000.0090,E,1,06,1.21,62.77,M,0.00,M,,*7B			
Parameter Description			
Field Name		Format	Parameter Description
1	$--GGA string		Message ID, GGA statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss The UTC time of the current location	
3	lat	ddmm.mmmm Latitude, the first 2 characters represent degrees, the following characters represent minutes	
4	uLat	character	Latitude: N-North, S-South
5	lon	dddmm.mmm m	Longitude, the first 3 characters represent degrees, the following characters represent minutes
6	uLon		Longitude direction: E-east, W-west
7	FS		Indicates the current positioning quality (note [1]), this field should not be empty
8	character value numSv value		The number of satellites used for positioning, 00~24
9	HDOP Numeric Numeric		Horizontal factor of precision (HDOP)
10	msl		Altitude, which is the height of the receiver antenna relative to the geoid
11	uMsl		Height unit, meters, fixed character M
12	sep	Character Numeric	The distance between the reference ellipsoid and the geoid, "-" means the geoid The level is below the reference ellipsoid
13	uSep character height unit, meters, fixed character M		
14	diffAge Numerical differential correction data age, this field is empty when DGPS is not used		
15	diffSta Numerical		ID of the differential reference station
16	CS	hexadecimal numerical checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
17	<CR><LF> characters		carriage return and line feed
Remarks[1] Positioning Quality Mark			
Positioning quality marks		describe	
0		Targeting unavailable or invalid	
1		SPS positioning mode, positioning is valid	
6		Estimation Mode (Dead Reckoning) Only valid for NMEA2.3 and above	

1.5.2 GLL

Information GLL			
Describes information such as latitude, longitude, positioning time and positioning status.			
type output			
Format $--GLL,lat,uLat,lon,uLon, UTCtime,valid,mode*CS<CR><LF>			
Example $GPGLL,2959.9925,S,12000.0090,E,235316.000,A,A*4E			
Parameter Description			
Field Name		Format	Parameter Description
1	$--GLL string		Message ID, GLL statement header, '--' is the system identifier
2	lat	ddmm.mmmm Latitude, the first 2 characters represent degrees, the following characters represent minutes	
3	uLat	character	Latitude: N-North, S-South
4	lon	dddmm.mmm m	Longitude, the first 3 characters represent degrees, the following characters represent minutes
5	uLon		Longitude direction: E-east, W-west
6	UTCtime	Character hhmmss.sss The UTC time of the current location	
7	valid	Character data validity (remarks [1])	
8	mode Character positioning mode (Note [2]), hexadecimal value checksum,	Only valid for NMEA 2.3 and above	
9	CS	XOR of all characters between $ and * (excluding $ and *) fruit	
10	<CR><LF> characters	carriage return and line feed	
Remarks [1] Data validity flag			
Positioning Quality Mark Description			
A	Data is valid		
V	Invalid data		
Remark[2] Positioning mode flag			
Location mode flag	describe		
A	autonomous mode		
E	Estimation Mode (Dead Reckoning)		
N	Invalid data		
D	Differential mode		
M	Not located, but there is an external input or a location where history is saved		

1.5.3 GSA

Information GSA			
Describes the satellite number and DOP information used for positioning. Output GSA regardless of location or availability of satellites statement; when the receiver is in the joint operation of multiple systems, the available satellites of each system correspond to a GSA statement, Each GSA statement contains PDOP, HDOP, and VDOP from the combined satellite system.			
type output			
Format $--GSA,smode,FS{,SVID},PDOP,HDOP,VDOP*CS<CR><LF>			
Example $GPGSA,A,3,05,21,31,12,18,29,,,,,,,2.56,1.21,2.25*01			
Parameter Description			
Field Name		Format	Parameter Description
1	$--GSA string smode		Message ID, GSA statement header, '--' is the system identifier
2	alphanumeric		Mode switching mode indication (Note [1])
3	FS		Positioning status flag (Note [2])
4	{,SVID} numeric value		Satellite number used for positioning, this field shows a total of 12 available satellites number, if more than 12, only the first 12 will be output, and if less than 12, it will not be output Foot area fill up
5	PDOP value		Position Factor of Precision (PDOP)
6	HDOP value		Horizontal factor of precision (HDOP)
7	VDOP value systemId value		Vertical Factor of Precision (VDOP)
8			GNSS system ID number defined by NMEA (Note [3]) Onlyvalid for NMEA 4.1 and above
9	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
10	<CR><LF> characters		carriage return and line feed
Remark[1] Mode switch mode indication			
Mode switch mode indication description			
M	Switch manually. Force 2D or 3D working mode		
A	switch automatically. Receiver automatically switches 2D/3D working mode		
Remark[2] Positioning status flag			
Positioning status	describe		
1	Invalid targeting		
2	2D positioning		
3	3D positioning		
Remark[3] GNSS System ID			
System ID	describe		
1	GPS system		
2	GLONASS system		
4	BDS system		

1.5.4 GSV

Information GSV	
Describes the satellite number of the visible satellite and its elevation, azimuth, carrier-to-noise ratio and other information. {satellite code in each GSV statement Number, elevation, azimuth, carrier-to-noise ratio} The number of parameter groups is variable, the maximum is 4 groups, and the minimum is 0 groups.	
type output	
Format $--GSV,numMsg,msgNo,numSv{,SVID,ele,az,cn0} *CS<CR><LF>	
Example $GPGSV,3,1,10,25,68,053,47,21,59,306,49,29,56,161,49,31,36,265,49*79 $GPGSV,3,2,10,12,29,048,49,05,22,123,49,18,13,000,49,01,00,000,49*72 $GPGSV,3,3,10,14,00,000,03,16,00,000,27*7C	

Parameter Description

Field Name		Format	Parameter Description
1	$--GSV string numMsg		Message ID, GSV statement header, '--' is the system identifier
2	characters		Total number of statements. Output up to 4 visible satellites per GSV statement information, so when more than 4 satellites are visible to the system, more GSV statement.
3	msgNo Number numSv		current statement number
4	Number		Total number of visible satellites
5	{,SVID,ele, numeric az,cn0}		as followed: satellite number; Elevation angle, the value range is 0~90, the unit is degree; Azimuth, the value range is 0~359, the unit is degree; Carrier-to-noise ratio, the value range is 0~99, and the unit is dB-Hz. If the current satellite is tracked, fill the space
6	signalId value		GNSS signal ID defined by NMEA (0 means all signals) Only valid for NMEA 4.1 and above
7	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
8	<CR><LF> characters		carriage return and line feed

1.5.5 RMC

Information RMC			
Describe the recommended minimum positioning information			
type output			
Format $--RMC,UTCtime,status,lat,uLat,lon,uLon,spd,cog,date,mv,mvE,mode*CS<CR><LF>			
Example $GPRMC,235316.000,A,2959.9925,S,12000.0090,E,0.009,75.020,020711,,,A*45			
Parameter Description			
Field Name		Format	Parameter Description
1	$--RMC string		Message ID, RMC statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss The UTC time of the current location	
3	status	String position valid flag. V=Receiver warning, invalid data A = data valid	
4	lat	ddmm.mmmm Latitude, the first 2 characters represent degrees, the following characters represent minutes	
5	uLat	character	Latitude: N-North, S-South
6	lon	dddmm.mmmm	Longitude, the first 3 characters represent degrees, the following characters represent minutes
7	uLon		Longitude direction: E-east, W-west
8	spd	character	Ground speed in knots
9	cog	numeric value	True heading over ground, in degrees
10	date	ddmmyy	Date (dd is day, mm is month, yy is year)
11	mv	numeric	Magnetic declination, in degrees. fixed empty
12	mvE	character	Magnetic Declination Direction: E-East, W-West. fixed empty
13	mode character		Positioning mode flag (Note [1]) only*NMEA 2.3* and above versions are valid
14	navStatus character		Navigation status identifier (V means that the system does not output navigation status information) Only valid for NMEA 4.1 and above
15	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
16	<CR><LF> characters		carriage return and line feed
Remark[1] Positioning mode flag			
Location mode flag	describe		
A	autonomous mode		
E	Estimation Mode (Dead Reckoning)		
N	Invalid data		
D	Differential mode		
M	Not located, but there is an external input or a location where history is saved		

1.5.6 VTG

Information VTG			
Describes ground speed and course information.			
type output			
Format $--VTG,cogt,T,cogm,M,sog,N,kph,K,mode*CS<CR><LF>			
Example $GPVTG,75.20,T,,M,0.009,N,0.017,K,A*02			
Parameter Description			
Field Name		Format	Parameter Description
1	$--VTG string cogt numeric		Message ID, VTG statement header, '--' is the system identifier
2	character cogm numeric	character	True North heading over the ground, in degrees
3	T	numeric	True North indication, fixed at T
4	character numeric character		Heading to magnetic north, in degrees
5	M	mode	Magnetic north indication, fixed as M
6	sog	character	Ground speed in knots
7	N		Speed unit knot, fixed as N
8	kph		Ground speed in kilometers per hour
9	K		Speed unit, kilometers per hour, fixed at K
10			Positioning mode flag (Note [1]) only *NMEA 2.3* and above versions are valid
11	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
12	<CR><LF> Character		carriage return and line feed
remarks [1] Positioning mode flag			
Location mode flag	describe		
A	autonomous mode		
E	Estimation Mode (Dead Reckoning)		
N	Invalid data		
D	Differential mode		
M	Not located, but there is an external input or a location where history is saved		

1.5.7 ZDA

Information ZDA			
Describes time and date information.			
type output			
Format $--ZDA,UTCtime,day,month,year,ltzh,ltzn*CS<CR><LF>			
Example $GPZDA,235316.000,02,07,2011,00,00*51			
Parameter Description			
Field Name		Format	Parameter Description
1	$--ZDA string		Message ID, ZDA statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss UTC time when positioning	
3	day Numerical day, fixed two digits, the value range is 01~31		
4	month Numeric month, fixed two digits, the value range is 01~12		
5	year	Numeric	year, fixed four digits
6	ltzh	value The hour in this time zone, not supported, fixed at 00	
7	ltzn		Minutes in this time zone, not supported, fixed at 00
8	CS	Numerical hexadecimal value checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
9	<CR><LF> characters		carriage return and line feed

1.5.8 TXT

product information

Information TXT	
Describe product information	
Type output, output once when power on	
Format $GPTXT,xx,yy,zz,info*hh<CR><LF>	
Example $GPTXT,01,01,02,MA=CASIC*27	Indicates the name of the manufacturer (CASIC) $GPTXT,01,01,02,IC=ATGB03+ATGR201*71 Indicates the model of the chip or chipset (baseband chip model ATGB03, RF chip model ATGR201) $GPTXT,01,01,02,SW=URANUS2,V2.2.1.0*1D Indicates the software name and version number (software name URANUS2, version number V2.2.1.0) $GPTXT,01,01,02,TB=2013-06-20,13:02:49*43 Indicates code compile time (Jun 20, 2013, 13:02:49) $GPTXT,01,01,02,MO=GB*77 Indicates the working mode of the receiver this time (GB indicates the dual-mode mode of GPS+BDS) $GPTXT,01,01,02,CI=00000000*7A Indicates customer number (customer number is 00000000)

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT String value		Message ID, TXT statement header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, Need to be divided into multiple pieces of information to display
3	yy		Statement number 01~99
4	zz	Numeric value	text identifier. 00=error message; 01=warning message; 02 = notification information; 07=User information.
5	info		text message
6	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
7	<CR><LF> characters		carriage return and line feed

1.5.9 ANT

Information ANT	
describe antenna status	
type output	
Format $GPTXT,xx,yy,zz,info*hh<CR><LF>	
Example $GPTXT,01,01,01,ANTENNA OPEN*25 Indicates antenna status (open circuit) $GPTXT,01,01,01,ANTENNA OK*35 Indicates antenna status (good) $GPTXT,01,01,01,ANTENNA SHORT*63 Indicates antenna status (short circuit)	

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT String value		Message ID, TXT statement header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, It needs to be divided into multiple pieces of information display, which is fixed at 01.
3	yy		Statement number 01~99, fixed at 01.
4	zz	Numeric value	text identifier. Fixed to 01.
5	info		text message ANTENNA OPEN=Antenna open ANTENNA OK=Antenna is good ANTENNA SHORT=Antenna short circuit
6	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
7	<CR><LF> characters		carriage return and line feed

1.5.10 DHV

Information DHV			
Details describing the receiver speed			
type output			
Format $--DHV,UTCtime,speed3D,spdX,spdY,spdZ,gdspd*CS<CR><LF>			
Example $GNDHV,021150.000,0.03,0.006,-0.042,-0.026,0.06*65			
Parameter Description			
Field Name		Format	Parameter Description
1	$--DHV string		Message ID, DHV statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss The UTC time of the current moment	
3	speed3D value value		Receiver three-dimensional velocity, in m/s
4	spdY value spdZ value spdX		Receiver ECEF-X-axis speed, in m/s
5	gdspd value		Receiver ECEF-Y-axis speed, in m/s
6			Receiver ECEF-Z axis speed, unit is m/s
7			The speed of the receiver in the horizontal ground direction, in m/s
8	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
9	<CR><LF> characters		carriage return and line feed

1.5.11 LPS (only 5T support)

Information LPS (only 5T support)	
Describe leap second information	
type output	
Format $GPTXT,xx,yy,zz,LS=system,valid,utcLS,utcLSF,utcTOW,utcWNT,utcDN,utcWNF ,utcA0,utcA1,leapDt,dateLsf,lsfExp,wnExp,wnExpNum*hh<CR><LF>	
Example $GNZDA,235402.000,31,12,2016,00,00*4E The current UTC time is December 31, 2016, 23:54:02 $GPTXT,01,01,02,LS=0,3,17,18,61,138,7,137,0,0,358,311216,,,*64 The leap second information of GPS is valid and used for timing, the current leap second and the leap second after the jump are not equal, jumping from 17 seconds to 18 seconds, the leap second event occurred 358 seconds later (that is, 23:59:60 on December 31, 2016). current The receiver GPS system has no satellites that give abnormal UTC parameter information alarms. Currently no GPS week number is given warning satellite. $GPTXT,01,01,02,LS=1,1,3,4,0,61,6,61,0,0,358,311216,,,*56 The leap second information of Beidou is valid and not used for timing, the current leap second and the leap second after the jump are not equal, jumping from 3 seconds to 4 seconds seconds, the leap second event occurred 358 seconds later (that is, 23:59:60 on December 31, 2016). Notice: The leap seconds of GPS and Beidou are different because their time starting reference points are different. The current receiver Beidou system There are no satellites that give abnormal UTC parameter information alarms. There are currently no satellites that have given abnormal Beidou week numbers.	

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT String value		Message ID, TXT statement header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, It needs to be divided into multiple pieces of information display, which is fixed at 01.
3	yy	numeric	Statement number 01~99, fixed at 01.
4	zz	numeric	text identifier. Fixed to 02.
5	LS=	string	Leap second message identifier, fixed character.
6	system characters		The system corresponding to the leap second information. 0=GPS 1=BDS (Beidou)
7	valid	character	Leap second information valid flag. When multiple satellite systems are co-located, only Have one of these systems for timing (calibrate 1PPS and UTC time) 0=Invalid leap second information 1 = Leap second information is valid, but the system is not used for timing 2 = Leap second information is invalid, but the system is already used for timing 3 = Leap second information is valid and the system has been used for timing
8	utcLS	Numerical value	(Fields 8-15 are standard leap second 8 parameters, please refer to Beidou or ICD document for GPS) The current leap second, in seconds, a positive number means the satellite time is ahead of UTC time. Output if the leap second parameter is valid, otherwise empty.
9	utcLSF value		Predicted leap second (after a leap second event), in seconds, positive table

			Indicates that the satellite time is ahead of the UTC time. Output when the leap second parameter is valid, Otherwise empty.
10	utcTOW value		The reference time of the UTC correction parameter, within the week, in 4096 seconds. Output if the leap second parameter is valid, otherwise empty.
11	utcWNT value		The reference time for the UTC correction parameter, in weeks, in weeks, modulo 256. Output if the leap second parameter is valid, otherwise empty.
12	utcDN value		The time the leap second occurred, the number of days in the week. For GPS system, the valid value range of this value is 1~7. For Beidou system, the valid value range of this value is 1~6. 1 means the end of Sunday, 2 means the end of Monday, and so on Push, 7 means the end of Saturday. Output if the leap second parameter is valid, otherwise empty.
13	utcWNF value		The time at which the leap second occurred, the number of weeks, in weeks, modulo 256. leap second parameter Output when the number is valid, otherwise empty.
14	utcA0 value		time error between UTC time and satellite time (scale factor 2^-30), The unit is seconds. Output if the leap second parameter is valid, otherwise empty.
15	utcA1	Numerical value	The rate of change of time error between UTC time and satellite time (scale factor 2^-50) in sec/sec. Output when the leap second parameter is valid, otherwise Is empty.
16	leapDt value		The time between the moment of the leap second event and the current UTC time interval, a positive number indicates that a leap second event will occur in the future. The leap second parameter is valid and Output when there is a leap second change (utcLsÿutcLsf), otherwise it is empty.
17	dateLsf	ddmmyy	The date corresponding to the predicted leap second occurrence time, in day/month/year format. leap Output when the second parameter is valid and there is a leap second change (utcLsÿutcLsf), Otherwise empty.
18	lsfExp	The hexadecimal value is an abnormal alarm for the leap second correction time of the current satellite system. in 8-bit	The hexadecimal value is relative to the system's 32 satellites. from The lowest to highest order is No. 1 to No. 32 satellites. 0=There is no abnormality in the leap second correction information of this satellite. 1=The satellite's leap second correction information is abnormal. If the time of the leap second in the message is not the empirical time (June 30 or December 31), the receiver will give abnormal information, but will follow the changes. The changed time is adjusted for leap seconds. Leap second parameter is valid with exception output, otherwise empty.
19	wnExp	Hexadecimal value Abnormal alarm (year jump alarm) of the current satellite system time and week number. Take 8	The hexadecimal value of the digit indicates the relative information of the 32 satellites of the system. condition. From the lowest position to the highest position are No. 1 to No. 32 satellites. 0=No abnormality in the number of weeks of the satellite, no alarm 1=There is an abnormality in the number of weeks of the satellite, and an alarm is given Output when the ephemeris time is abnormal. Otherwise empty.
20	wnExpNum value		The magnitude of the cycle number jump in the satellite message. Weeks jump forward relative to normal If it changes, the value is negative; otherwise, it is positive. The unit is the number of weeks. Ephemeris Output when there is an exception between. Otherwise empty.
twenty one	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	

			fruit
twenty two	<CR><LF> characters		carriage return and line feed

1.5.12 UTC (only 5T supported)

Information UTC (only 5T supported)			
Description of receiver status, simplified information for leap second correction			
type output			
Format $--UTC,UTCtime,lat,uLat,lon,uLon,FS,numSv,HDOP,hgt,uMsl,date,antSta,time Src,leapValid,dtLs,dtLsf,leapTime*CS<CR><LF>			
Example $GNUTC,235402.000,3200.00001,N,11900.00005,E,1,20,0.6,10.5,M,311216,0,0,1, 17,18,1216*3C			
Parameter Description			
Field Name		Format	Parameter Description
1	$--UTC string		Message ID, UTC statement header
2	UTCtime	hhmmss	The currently positioned UTC time in the format of hours/minutes/seconds.
3	lat	ddmm.mmmm Latitude, the first 2 characters represent degrees, the following characters represent minutes	
4	uLat	Character	Latitude: N-North, S-South
5	lon	dddmm.mmmm longitude, the first 3 characters represent degrees, the following characters represent minutes	
6	uLon		Longitude direction: E-east, W-west
7	FS		Indicates the current positioning quality (note [1]), this field should not be empty
8	character value numSv value		The number of satellites used for positioning, 00~24
9	HDOP Number hgt Number		Horizontal factor of precision (HDOP)
10	character ddmmyy antSta		high
11	uMsl		Height unit, meters, fixed character M
12	date	Number	The current targeting date in day/month/year format.
13			Antenna Status: 0=Antenna is open 2=Antenna is normal 3=Antenna short circuit
14	timeSrc value		Current timing source system: 0=GPS system 1=BDS system
15	leapValid value		Leap second correction value validity flag: 0 = no valid leap second value 1 = Leap second value is valid
16	utcLs		The leap second correction value of the current time
17	Numeric utcLsf Numeric		If there is a predicted leap second (utcLsÿ in the leap second correction information utcLsf), which represents the forecasted new leap second correction value. On leap second event After birth, this value is continuously output until a modification without leap second forecast is received. until positive information. If no leap second is predicted (dtls in the received leap second correction

			equal to dtlsf), the field is empty
18	leapTime mmyy		If there is a predicted leap second (utcLsÿ in the leap second correction information utcLsf), which indicates the predicted leap second occurrence time. at leap second After the event, the value will continue to be output until no leap second prediction is received. until the correction information is reported. If no leap second is predicted (dtls and dtlsf), the field is empty. The format is month/year.
19	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
20	<CR><LF> characters		carriage return and line feed

Remarks[1] Positioning Quality Mark	
Positioning quality marks	describe
0	Targeting unavailable or invalid
1	Standard positioning mode, positioning is effective
6	Estimation mode

1.5.13 GST

Information GST			
Describes measurement accuracy details for receiver pseudoranges			
type output			
Format $--GST,UTCtime,RMS,stdDevMaj,stdfDevMin,orientation,stdLat,stdLon,stdAlt* CS<CR><LF>			
Example $BDGST,081409.000,0.5,,,,0.2,0.1,0.4*5E			
Parameter Description			
Field Name		Format	Parameter Description
1	$--GST string		Message ID, DHV statement header, '--' is the system identifier
2	UTCtime	hhmmss.sss The UTC time of the current moment	
3	RMS	RMS value of receiver pseudorange error standard deviation during numerical positioning, in meters	
4	stdDevMaj Numerical receiver ellipse semi-major axis position standard deviation, not supported		
5	stdfDevMin Numerical receiver ellipse semi-minor axis position standard deviation, not supported		
6	orientation Numerical receiver ellipse semi-major axis orientation, not supported		
7	stdLat Standard deviation of numerical receiver latitude error, in meters		
8	stdLon The standard deviation of the longitude error of the numerical receiver, in meters		
9	stdAlt	Standard deviation of the numerical receiver altitude error, in meters	
10	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	
11	<CR><LF> characters	carriage return and line feed	

1.5.14 INS (only supported by 5S series)

Information INS (only supported by 5S series)	
Describe Inertial Navigation System (INS) information	
type output	
Format $GPTXT,xx,yy,zz,INS_INF=sensorID,attMode,status,sesorOK,RAM, ramStart*hh<CR><LF>	
Example $GPTXT,01,01,02,INS_INF=1,3,5,0,0,RAM,1*11 explain: k=1, the current module sensor type 1; l=3, when the module package X-axis is installed, it needs to only be on the left side of the vehicle; m=5, the module currently outputs RXM_SENSOR statement, each statement has 5 groups of MEMS sampling data; n=0, the combined navigation filter does not converge.	

Parameter Description

Field Name		Format	Parameter Description
1	$GPTXT String value		Message ID, TXT statement header
2	xx		The total number of sentences in the current message is 01~99. If a message is too long, It needs to be divided into multiple pieces of information display, which is fixed at 01.
3	yy		Statement number 01~99, fixed at 01.
4	zz	Numeric value	text identifier.
5	INS_INF string		Fixed to INS_INF for INS information flags.
6	sensorID value attMode value		Sensor type used by the current module: 1 or 2.
7			Mode configuration of the module relative to the relative installation attitude of the vehicle, possible values Range: 0, 1, 2, 3. 0: The module X axis points to the front of the vehicle. 1: The module X-axis points to the right of the vehicle. 2: The module X-axis points to the rear of the vehicle. 3: The module X-axis points to the left of the vehicle. 9: Adaptive estimation module relative pose.
8	fs	Numerical value	Used only for output of internal MEMS raw data The number of samples within the RXM_SENSOR statement. Value range: 0, 1, 2, 5, 10, 25, 50. If m=0, it means that the RXM_SENSOR statement does not output; If m!=0, it means that the RXM_SENSOR statement is output once per second, A statement contains m groups of MEMS sensor sampling data.
9	status	Numerical value	It is used to display the convergence status of the combined navigation filter, n=2 means it has been received Convergence.
10	sesorOK value		-
11	RAM	string	Fixed to RAM
	ramStart value		1: With backup power on, the dead reckoning function is turned on immediately 0: The dead reckoning function is turned off immediately after power-on with a backup power supply

			Off by default
6	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
7	<CR><LF> characters		carriage return and line feed

1.6 NMEA Custom Messages

1.6.1 CAS00

Information CAS00			
Description Save the current configuration information to the FLASH, even if the receiver is completely powered off, the information in the FLASH will not be lost.			
Type input			
Format $PCAS00*CS<CR><LF>			
Example $PCAS00*01			
Parameter Description			
Field Name		Format parameter description	
1	$PCAS00 String message ID, statement header		
2	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
3	<CR><LF> characters		carriage return and line feed

1.6.2 CAS01

Information CAS01			
Description Set the serial communication baud rate.			
Type input			
Format $PCAS01,br*CS<CR><LF>			
Example $PCAS01,1*1D			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS01 String number		message ID, statement header
2	br		Baud rate configuration. 0=4800bps 1=9600bps 2=19200bps 3=38400bps 4=57600bps 5=115200bps
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		carriage return and line feed

1.6.3 CAS02

Information CAS02			
Description Sets the location update rate.			
Type input			
Format $PCAS02,fixInt*CS<CR><LF>			
Example $PCAS02,1000*2E			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS02 String value		message ID, statement header
2	fixInt		Positioning update interval, in ms. 1000=update rate 1Hz, output 1 fix point per second 500=update rate 2Hz, output 2 fix points per second 250=update rate 4Hz, output 4 fix points per second 200=update rate 5Hz, output 5 fix points per second 100=update rate 10Hz, output 10 fix points per second
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	
4	<CR><LF> characters		carriage return and line feed

1.6.4 CAS03

Information CAS03	
Description Sets the NMEA sentence that requires or stops being output.	
Type input	
Format $PCAS03,nGGA,nGLL,nGSA,nGSV,nRMC,nVTG,nZDA,nANT,nDHV,nLPS,res1,r es2,nUTC,nGST,res3,res4,res5,nTIM*CS<CR><LF>	
Example $PCAS03,1,1,1,1,1,1,1,1,0,0,,,1,1,,,,1*33	

Parameter Description

Field Name		Format	Parameter Description
1	$PCAS03 String nGGA value		message ID, statement header
2			GGA output frequency, sentence output frequency is based on the positioning update rate , n (0~9) means output once every n positioning, 0 means no output This statement, if empty, keeps the original configuration.
3	nGLL	Numeric	GLL output frequency, same as nGGA
4	nGSA	value	GSA output frequency, same as nGGA
5	nGSV	value	GSV output frequency, same as nGGA
6	NRMC numerical numerical		RMC output frequency, same as nGGA
7	nVTG		VTG output frequency, same as nGGA
8	nZDA		ZDA output frequency, same as nGGA
9	nANT		ANT output frequency, same as nGGA
10	nDHV		DHV output frequency, same as nGGA
11	nLPS		LPS output frequency, same as nGGA
12	res1		reserve
13	res2		reserve
14	nUTC		UTC output frequency, same as nGGA
15	nGST		GST output frequency, same as nGST
16	res3		reserve
17	res4		reserve
18	res5		reserve
19	nTIM		TIM (PCAS60) output frequency, same as nGGA
20	CS	numerical numerical values numerically numerically numerical value value Numeral value value value value value hexadecimal value check harmony, betweer	
twenty one	<CR><LF> characters		carriage return and line feed

1.6.5 CAS04

Information CAS04			
Describes the configuration work system.			
Type input			
Format $PCAS04,mode*hh<CR><LF>			
Example $PCAS04,3*1A BeiDou and GPS dual mode $PCAS04,1*18 Single GPS working mode $PCAS04,2*1B Single Beidou working mode			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS04 string mode number		message ID, statement header
2			Working system configuration. For featured product models, the following departments are supported sub-configuration. 1=GPS 2=BDS 3=GPS+BDS 4=GLONASS 5=GPS+GLONASS 6=BDS+GLONASS 7=GPS+BDS+GLONASS
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		carriage return and line feed

1.6.6 CAS05

Information CAS05			
Description Sets the NMEA protocol type selection. There are many types of protocols for multi-mode navigation receivers, and the data protocol standards are also More, this receiver product can support a variety of (Optional) .			
protocol type input			
Format $PCAS05,ver*CS<CR><LF>			
Example $PCAS05,1*19			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS05 string mode number		message ID, statement header
2			NMEA protocol type selection (Note [1])
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		carriage return and line feed
Remark[1] NMEA protocol type selection			
2	Compatible with NMEA 4.1 and above		
5	Compatible with BDS/GPS dual-mode protocol of China Transportation Information Center, compatible with NMEA 2.3 and above, compatible with NMEA4.0 protocol		
9	Compatible with single GPS NMEA0183 protocol, compatible with NMEA 2.2 version		

1.6.7 CAS06

Information CAS06			
DescriptionQuery product information			
Type input			
Format $PCAS06,info*CS<CR><LF>			
Example $PCAS06,0*1B			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS06 String number		message ID, statement header
2	info		Query the information type of the product. Information content refer to 1.5.8. 0=Query firmware version number 1=Query the hardware model and serial number 2=Query the working mode of the multimode receiver 3=Query the customer number of the product 5=Query upgrade code information
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		carriage return and line feed

1.6.8 CAS10

Information CAS10	
Description Receiver reboot	
Type input	
Format $PCAS10,rs*CS<CR><LF>	
Example $PCAS10,0*1C warm start $PCAS10,1*1D warm start $PCAS10,2*1E Cold start $PCAS10,3*1F Factory Boot	

Parameter Description

Field Name		Format	Parameter Description
1	$PCAS10 string number		message ID, statement header
2	rs		Boot mode configuration. 0=warm start. Without using initialization information, back up all Data is valid. 1=warm start. Clear the ephemeris without using initialization information. 2=Cold start. Do not use initialization information, clear the backup storage except All data except configuration. 3=Factory start. Clear all data in memory and reset the receiver to the factory default configuration.
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *) fruit	
4	<CR><LF> characters		carriage return and line feed

1.6.9 CAS12

Information CAS12			
Description Receiver Standby Mode Control 5L Low power modules support this command			
Type input			
Format $PCAS12,stdbysec*CS<CR><LF>			
Example $PCAS12,60*28 The receiver goes into standby mode and automatically turns on after 60 seconds			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS12 String stdbysec value		message ID, statement header
2			Time for receiver to enter standby mode, maximum 65535 seconds
3	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
4	<CR><LF> characters		carriage return and line feed

1.6.10 CAS20

Information CAS20			
Describe online upgrade instructions			
Type input			
Format $PCAS20*CS<CR><LF>			
Example $PCAS20*03			
Parameter Description			
Field Name		Format	Parameter Description
1	$PCAS20 String		message ID, statement header
2	CS	Hexadecimal checksum, XOR of all characters between $ and * (excluding $ and *)	fruit
3	<CR><LF> characters		carriage return and line feed

1.6.11 CAS15

Information CAS15	
Describes satellite system control commands, which can be configured to receive any satellite in the system V5200 Subsequent versions support this command	
Type input	
Format $PCAS15,X,YYYYYYYY*CS<CR><LF>	
Example $PCAS15,2,FFFFFFFF*37, enable Beidou satellites 1-32 $PCAS15,2,FFFFFFE0*42, Beidou satellites 6-32 are turned on, Beidou satellites 1-5 are turned off $PCAS15,4,FFFF*31, enable SBAS satellites 1-16, ie PRN=120-135 $PCAS15,5,1F*47, enable QZSS satellites 1-5, ie PRN=193, 194, 195, 199, 197	

Parameter Description

Field Name		Format	Parameter Description
1	$PCAS15 String		message ID, statement header
2	SYS_ID 1 number		2=Beidou 1-32 satellites 3 = Beidou 33-64 satellite 4=SBAS satellites (SBAS satellites 1-19, corresponding to PRN 120-138 No) 5=QZSS satellites (QZSS satellites 1-5, corresponding to PRN 193, 194, 195, 199, 197)
3	SV_MASK 1 to 8 hex	Numerical value	Each hex character controls 4 satellites, the rightmost controls 1-4 satellite. Hexadecimal characters are converted to 4bit binary, each 1bit corresponds to 1 guard satellite, 1=receive this satellite; 0=disabled. For example: 3FFFFFE0, which means that satellites 31, 32, 1-5 are prohibited.
4	CS	Hexadecimal checksum,	XOR of all characters between $ and * (excluding $ and *) fruit
5	<CR><LF> characters		carriage return and line feed

1.6.12 CAS60

Information CAS60	
Describes receiver time information. 5T-V5302 module Subsequent versions support this command	

type output	
Format	$PCAS60,UTCtime,ddmmyyyy,wn,tow,timevalid,leaps,leapsValid*CS
Example	$PCAS60,091242.000,23122019,2085,119580,1,18,1*33 $PCAS60,091222.000,23122019,,,0,,0*33 $PCAS60,092011.000,23122019,2085,120029,1,,0*33

Parameter Description

Field Name		Format	Parameter Description
1	$PCAS60 String		message id
2	UTCtime	hhmmss.sss The UTC time of the current moment, if leapsValid is 0, the Default leaps calculation	
3	ddmmyyy y	Numerical value	current day month year
4	wn	Numerical value	GPS system week number
5	tow	Numerical value	GPS System Seconds of the Week
6	timeValid value		Time validity (2/3/4/5 fields), 1=valid, 0=invalid
7	leaps number		Difference between GPS time and UTC time, leap seconds
8	leapsValid value		Validity of leap seconds leaps, 1=valid, 0=invalid
9	CS	hexadecimal value checksum, $ and result between (excluding $ and) XOR of all characters	
10		character	carriage return and line feed

2 CASIC protocol

2.1 CASIC Protocol Features

CASIC receivers use a custom standard interface protocol (CSIP, CASIC Standard Interface Protocol)

Send data to the host, the data is transferred asynchronously serially.

2.2 CASIC Protocol Framework

CSIP packet structure

field 1	field 2	field 3	field 4	field 5	field 6
header	payload length message	class message	number payload	unsigned short	check value
0xBA, 0xCE	2 bytes	bytes 1	1 bytes < 2k bytes		unsigned int 4 bytes

Field 1: message header (0xBA, 0xCE)

Four hexadecimal characters are used as the message start delimiter character (message header), occupying two bytes.

Field 2: Payload Length (len)

The message length (two bytes) indicates the number of bytes occupied by the payload (field 5), excluding the message header, message type, Message number, length, and checksum fields.

Field 3: message class (class)

Occupies one byte, indicating the basic subset to which the current message belongs.

Field 4: Message number (id)

The message class is followed by a one-byte message number.

Field 5: Payload

The payload is the specific content of the data packet transmission, and its length (number of bytes) is variable and is an integer multiple of 4.

Field 6: Checksum (ckSum)

The checksum is the word by word (1 word includes 4) of all data from field 2 to field 5 inclusive Bytes) cumulative sum, occupying 4 bytes.

The calculation of the check value can follow the following algorithm:

```
ckSum = (id << 24) + (class << 16) + len;
for (i = 0; i < (len / 4); i++)
{
    ckSum = ckSum + payload[i];
}
```

In the formula, payload contains all the information of field 5. In the calculation process, the part of field 2 to field 4 is firstly Assemble (4 bytes form a word), and then put the data in field 5 in the order of a group of 4 bytes (the first received is in the lower order) Accumulate.

2.3 CASIC type and number

Each type of interaction message for a CASIC receiver is a collection of related messages.

name type description	
NAV 0x01 Navigation result: position, speed, time	
TIM	0x02 Timing message: time pulse output, time stamp result
RXM 0x03 Measurement information output by the receiver (pseudorange, carrier phase, etc.)	
ACK 0x05	ACK/NAK message: acknowledgment message to CFG message
CFG 0x06 Input configuration message: configure navigation mode, baud rate, etc.	
MSG 0x08 Satellite message information output by receiver	
MON 0x0A Monitoring messages: communication status, CPU load, stack utilization, etc.	
AID	0x0B Auxiliary messages: ephemeris, almanac and other A-GPS data

2.4 CASIC Payload Definition Rules

2.4.1 Data encapsulation

In order to implement structured data encapsulation more easily, the data in the payload part is arranged in a specific way: each type of The data in the message is tightly packed, with 2-byte values placed at offsets that are multiples of 2, and 4-byte values at offsets that are multiples of 4.

2.4.2 Message naming

The name of the message consists of a structure in the form of "message type + message name". For example, the configuration message for configuring PPS is named: CFG-PPS.

2.4.3 Data Types

Unless otherwise defined, all multi-character values are in little-endian format. All floating point values are in accordance with IEEE754 Single and double precision standard transfers.

Abbreviation type	Byte count	remarks
U1 unsigned char	1	
I1 Signed character	1	complement
U2 Unsigned Short I2 Signed	2	
Short U4 Unsigned Long I4	2	complement
Signed Long IEEE754 Single	4	
Precision	4	complement
R4	4	
R8 IEEE754 double precision	8	

2.5 CASIC message interaction

Mechanisms that define the input and output of receiver messages. When the receiver receives a CFG type message, it needs to To check whether the message is processed correctly, reply with an ACK-ACK or ACK-NACK message. Reply at the receiver with a received The sender MUST NOT send a second CFG message before the CFG message. Other messages received by the receiver do not require a reply.

2.6 CASIC message overview

page message name	Class/ID length type description			
Class NAV			NAV navigation results	
NAV-STATUS	0x01 0x00	80	Periodic receiver navigation status	
NAV-DOP	0x01 0x01	28	Periodic geometric precision factor	
NAV-SOL	0x01 0x02	72	Condensed PVT Navigation Information	
NAV-PV	0x01 0x03	80	Periodic position and velocity information	
NAV-TIMEUTC	0x01 0x10	twenty four	cycle	UTC time information
NAV-CLOCK	0x01 0x11	64	Periodic Clock Resolution Information	
NAV-GPSINFO 0x01 0x20	8+12*N period			GPS satellite information
NAV-BDSINFO	0x01 0x21	8+12*N cycles		BDS satellite information
NAV-GLNINFO 0x01 0x22	8+12*N cycles			GLONASS satellite information
Class TIM			TIM time message	
TIM-TP	0x02 0x00	twenty four	Periodic timing pulse information	
Class RXM			RXM receiver measurement information	
RXM-MEASX	0x03 0x10	16+32*N period pseudorange, carrier phase raw measurement information		
RXM-SVPOS	0x03 0x11	16+48*N period satellite position information		
Class ACK			ACK/NACK message	
ACK-NACK	0x05 0x00	4	Reply to a message reply indicates that the message was not received correctly	
ACK-ACK	0x05 0x01	4	Reply to a message reply indicates that the message was received correctly	
Class CFG			CFG input configuration message	
CFG-PRT	0x06 0x00	0/8	Query/Set Query/Configure the working mode of the UART	
CFG-MSG	0x06 0x01	0/4 4	Query/Set query/configuration information sending frequency	
CFG-RST	0x06 0x02		Set reboot receiver/clear saved data structure	
CFG-TP	0x06 0x03	0/16	Query/Set Query/Configure the related parameters of the receiver PPS	
CFG-RATE	0x06 0x04 0/4		Query/Set Query/Configure the receiver's navigation rate	
CFG-CFG	0x06 0x05	4	Set clear, save and load configuration information	
CFG-TMODE	0x06 0x06	0/28	Query/Set Query/Configure the timing mode of the receiver PPS	
CFG-NAVX	0x06 0x07 0/44		Query/Set Query/Professional Configuration Navigation Engine Parameters	
CFG-GROUP	0x06 0x08	0/56	Query/set query/configure group delay parameters of GLONASS	
Class MSG			MSG receiver satellite message information	
MSG-BDSUTC	0x08 0x00	20	Periodic receiver outputs BDS system UTC information.	
MSG-BDSION	0x08 0x01	16	The periodic receiver outputs the ionospheric information of the BDS system.	
MSG-BDSEPH	0x08 0x02	92	Periodic receiver outputs BDS system ephemeris information.	
MSG-GPSUTC 0x08 0x05		20	Periodic receiver outputs GPS system UTC information.	
MSG-GPSION	0x08 0x06	16	Periodic receivers output GPS system ionospheric information.	
MSG-GPSEPH	0x08 0x07 72		The periodic receiver outputs GPS system ephemeris information.	
MSG-GLNEPH 0x08 0x08		68	Periodic receiver outputs GLN system ephemeris information.	
Class MON			MON monitor messages	
MON-VER	0x0A 0x04 64		Response to query output version information	

	MON-HW	0x0A 0x09 56		Cycle/query various configuration states of hardware
Class AID				AID assistance message
	AID-INI	0x0B 0x01	56	Query/input auxiliary position, time, frequency, clock frequency offset information
	AID-HUI	0x0B 0x03 60		Enter supplementary health information, UTC parameters, ionospheric parameters

2.7 NAV (0x01)

Navigation results: position, speed, time, accuracy, heading, geometric precision factor and number of satellites, etc. NAV messages are divided For several types, they contain different information.

2.7.1 NAV-STATUS (0x01 0x00)

INFORMATIONNAV-STATUS					
Describe receiver navigation status					
Type Cycle/Query					
information	head	Length (bytes) Identifier	0x01 0x00	Payload Checksum	
structure	0xBA 0xCE	80	See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	one bit	describe
0	U4	-	runTime	ms Running time to power-on/reset	
4	U2	-	fixInterval	ms positioning interval	
6	U1	-	posValid	- Locator mark (Note [1])	
7	U1	-	velValid	- Speed sign (Note [2])	
8	U1*32 -		gpsMsgFlag	-	Message validity of almanac and ephemeris for 32 GPS satellites Flag (Note [3])
40	U1*24 -		glnMsgFlag	-	Almanac and ephemeris messages for 24 GLONASS satellites Validity flag (Note [3])
64	U1*14 -		bdsMsgFlag	-	Message validity of almanac and ephemeris for 14 BDS satellites Flag (Note [3])
78	U1		gpsUtcionFlag -		Message validity indicator for GPS UTC and ionospheric information Chi (Note [4])
79	U1	-	bdsUtcionFlag -		Message validity standard for UTC and ionospheric information for BDS Chi (Note [4])

Remark[1]: Positioning mark	
Numerical description	
0 Positioning is invalid	
1	External input location
2	Roughly estimated location
3	keep the last location
4	dead reckoning
5	Quick mode positioning
6	2D positioning
7	3D positioning
8	GNSS+DR combined navigation

Remark[2]: Speed sign	
Numerical description	
0	invalid speed

1	speed of external input
2	Roughly estimated speed
3	keep the last speed
4	Speed estimation
5	fast mode speed
6	2D speed
7	3D speed
8	Speed of combined GNSS+DR navigation
Remark [3]: Message validity mark The upper 4 bits represent the message validity flag of the almanac, and the lower 4 bits represent the message validity flag of the ephemeris	
Numerical description	
0 missing	
1	unhealthy
2	Expired
3	efficient
Remark [4]: message validity mark The upper 4 bits represent the message validity flag of UTC parameters, and the lower 4 bits represent the message validity flag of ionospheric parameters	
Numerical description	
0 missing	
1	unhealthy
2	Expired
3	efficient

2.7.2 NAV-DOP (0x01 0x01)

INFORMATIONNAV-DOP				
Describe the positioning precision factor				
Type Cycle/Query				
information	head	length (bytes) identifier		Payload Checksum
structure	0xBA 0xCE	28	0x01 0x01	See table below 4 Bytes

payload content

character offset	data type	Proportion zoom	name	Unit description
0	U4	-	runtime	ms Running time to power-on/reset
4	R4	-	pDop	- Location DOP
8	R4	-	hDop	- Horizontal DOP
12	R4	-	vDop	- Vertical DOP
16	R4	-	nDop	- Northbound DOP
20	R4	-	eDop	- Eastbound DOP
twenty four	R4	-	tDop	- Time DOP

2.7.3 NAV-SOL (0x01 0x02)

Information NAV-SOL					
Describes PVT navigation information in the ECEF coordinate system					
Type Cycle/Query					
information	head	length (bytes) identifier		Payload Checksum	
structure	0xBA 0xCE	72	0x01 0x02	See table below 4 Bytes	
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	ms	Elapsed time to power-on/reset
4	U1	-	posValid	-	Positioning mark (remarks [1])
5	U1		velValid	-	Speed flag (Note [2])
6	U1	-	timeSrc	-	Time Source (Note [3])
7	U1	-	system	-	Multimode receive mode mask of the receiver (Note [4])
8	U1	-	numSV	-	The total number of satellites involved in the solution
9	U1	-	numSVGPS -		Number of GPS satellites involved in the solution
10	U1	-	numSVBDS -		Number of BDS satellites participating in the solution
11	U1	-	numSVGLN -		Number of GLONASS satellites involved in the solution
12	U2	-	res	-	reserve
14	U2	-	week	-	week number
16	R8	-	tow	s	during the week
twenty four	R8	-	ecefX	m	X coordinate in ECEF coordinate system
32	R8	-	ecefY	m	Y coordinate in ECEF coordinate system
40	R8	-	ecefZ	m	Z coordinate in ECEF coordinate system
48	R4	-	pAcc	M^2	The variance of the estimated accuracy error of the 3D position
52	R4	-	ecefVX	m/s	X velocity in ECEF coordinate system
56	R4	-	ecefVY	m/s	Y velocity in ECEF coordinate system
60	R4	-	ecefVZ	m/s	Z velocity in ECEF coordinate system
64	R4	-	sAcc	(m/s)^2 Variance of estimation accuracy error for 3D velocity	
68	R4	-	pDop	-	Location DOP
Remark[1]: Positioning mark					
Numerical description					
0	Invalid targeting				
1	External input location				
2	Roughly estimated location				
3	keep the last location				
4	dead reckoning				
5	Quick mode positioning				
6	2D positioning				
7	3D positioning				
8	GNSS+DR combined navigation				
Remark[2]: Speed sign					
Numerical description					

0	invalid speed
1	speed of external input
2	Roughly estimated speed
3	keep the last speed
4	Speed estimation
5	fast mode speed
6	2D speed
7	3D speed
8	Speed of combined GNSS+DR navigation
Remark[3]: Time source	
Time source description	
0	GPS timing, i.e. the time of week and the week number is the receiver's local time obtained from the GPS satellites
1	BDS
2	GLONASS
Note[4]: Multi-mode receiving mode	
Bit description	
B0	1=GPS satellites are used for positioning
B1	1=BDS satellites are used for positioning
B2	1=GLONASS satellites are used for positioning

2.7.4 NAV-PV (0x01 0x03)

Information NAV-PV					
Describe the position and velocity information in the geodetic coordinate system					
Type Cycle/Query					
information structure	head	length (bytes) identifier		Payload Checksum	
	0xBA 0xCE 80 payload		0x01 0x03	See table below 4 Bytes	
content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	ms	Elapsed time to power-on/reset
4	U1	-	posValid	-	Positioning mark (refer to 2.7.3 Remarks [1])
5	U1		velValid	-	Speed flag (refer to 2.7.3 Remarks [2])
6	U1	-	system	-	Multimode receive mode mask for the receiver (Refer to 2.7.3 Remarks [4])
7	U1	-	numSV	-	The total number of satellites involved in the solution
8	U1	-	numSVGPS -		Number of GPS satellites involved in the solution
9	U1	-	numSVBDS -		Number of BDS satellites participating in the solution
10	U1	-	numSVGLN -		Number of GLONASS satellites involved in the solution
11	U1	-	res	-	reserve
12	R4	-	pDop	-	Location DOP
16	R8	-	lon	°	longitude
twenty four	R8	-	lat	°	latitude
32	R4	-	height	m	Geodetic height (with reference to ellipsoid)
36	R4	-	sepGeoid m hAcc		Altitude anomalies (difference between the height of the earth and the altitude)
40	R4	-		m^2 Variance of horizontal position accuracy error	
44	R4	-	vAcc	m^2 Variance of vertical position accuracy error	
48	R4	-	velN	m/s	Northing velocity in ENU coordinate system
52	R4	-	velE	m/s	Easting Velocity in ENU Coordinate System
56	R4	-	velU	m/s	Celestial Velocity in ENU Coordinate System
60	R4	-	speed3D	m/s	3D speed
64	R4	-	speed2D	m/s	2D ground speed
68	R4	-	heading sAcc	°	course
72	R4	-		(m/s)^2 Variance of accuracy error of ground velocity	
76	R4	-	cAcc	°^2 Variance of accuracy error for heading (variance of heading)	

2.7.5 NAV-TIMEUTC (0x01 0x10)

INFORMATIONNAV-TIMEUTC					
Describe UTC time information					
Type Cycle/Query					
information	head	length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	twenty four	0x01 0x10 See table below 4 Bytes		

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	ms	Elapsed time to power-on/reset
4	R4	1/c 2	tAcc	s^2 time estimation accuracy	
8	R4	-	msErr	ms Residual error after milliseconds	
12	U2	-	ms	ms	The millisecond part of UTC time, the value range is 0~999
14	U2	-	year	year	UTC year (1999~2099)
16	U1	-	month	month UTC month (1~12)	
17	U1	-	day	day	UTC day of the month (1~31)
18	U1	-	hour	hour	Hours of the day in UTC (0~23)
19	U1	-	min	min	UTC hour and minute (0~59)
20	U1	-	sec	s	UTC minutes and seconds (0~59)
twenty one	U1	-	valid	-	Time valid flag (Note [1])
twenty two	U1	-	timeSrc	-	Timing system logo (Note [2])
twenty three	U1	-	dateValid -		Date valid flag (Note [3])

Remark[1]: Time valid flag	
Numerical description	
B0	Valid flag in UTC week, 0=invalid, 1=valid
B1	UTC week number valid flag, 0=invalid, 1=valid
B2	UTC leap second correction valid flag, 0=invalid, 1=valid

Remark[2]: Timing system logo	
Numerical description	
0	GPS timing
1	BDS timing
2	GLONASS timing

Remark[3]: Date valid sign	
Numerical description	
0	Invalid date
1	External input date
2	get date from satellite
3	Get reliable dates from multiple satellites

2.7.6 NAV-CLOCK (0x01 0x11)

INFORMATIONNAV-CLOCK					
Describes clock resolution information					
Type Cycle/Query					
information structure	head	length (bytes)	Identifier	Payload Checksum	
	0xBA 0xCE	64	0x01 0x11 See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime ms Run time until power on/reset		
4	R4	1/c	freqBias Clock drift (clock frequency deviation)		
8	R4	1/c^2 tAcc 1/c^2 fAcc	s^2 time precision (variance)		
12	R4	Start of repeating part	-	Frequency accuracy (variance)	
(N=0 for GPS, 1 for BDS, 2 for GLONASS)					
16+16*N R8		-	tow	ms time of week	
24+16*N R4		-	dtUtc	s	The fractional second part of the difference between satellite time and UTC time
28+16*N U2		-	wn	-	week number
30+16*N I1		-	leapS	-	UTC jump seconds, the whole difference between satellite time and UTC time seconds part
31+16*N U1		-	valid	-	time validity sign
The repetition part ends, the maximum value of N is (SYSTEM_ALL-1), and the current version is 2					

2.7.7 NAV-GPSINFO (0x01 0x20)

INFORMATIONNAV-GPSINFO					
Describe GPS satellite information					
Type Cycle/Query					
information	head	length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	8+12*N	0x01 0x20 See table below	4 Bytes	

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	-	Elapsed time to power-on/reset
4	U1	-	numViewSv	-	The number of visible satellites, the valid range is 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1		system	-	System Type (Note [1])
7	U1	-	res		reserve
Start of repeating part (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	channel number
9+12*N	U1	-	svid	-	satellite number
10+12*N	U1	-	flags	-	Satellite Status Mask (Note [2])
11+12*N	U1	-	quality	-	Quality Indication of Signal Measurements (Note [3])
12+12*N	U1	-	CN0	dB-Hz signal carrier to noise ratio	
13+12*N	I1	-	elev	°	Satellite elevation (-90~90)
14+12*N	I2	-	azim	°	Satellite Azimuth (0~360)
16+12*N	R4	-	prRes	m Pseudorange residuals	
end of repetition					

Remark[1]: System Type	
Numerical value	describe
0	GPS
1	BDS
2	GLONASS

Remark[2]: Satellite Status	
bits	describe
B0	1 = Satellite participates in the calculation
B1-B3	reserve
B4	1=Invalid satellite prediction information
B5	reserve
B7:B6	00=Reserved 01 = Satellite forecast information based on almanac 10=Reserved 11=Satellite forecast information based on ephemeris

Remark[3]: Quality Indication of Signal Measurements	
quality description	
BIT0	=1, indicating that the pseudorange measurement value prMes is valid
BIT1	=1, indicating that the carrier phase measurement value cpMes is valid

BIT2	=1, indicating that the half-cycle ambiguity is valid (inverted PI correction is valid)
BIT3	=1, indicating that the half-cycle ambiguity is subtracted from the carrier phase measurement
BIT4	reserve
BIT5	=1, indicating that the carrier frequency is valid
BIT6-BIT7	reserve

2.7.8 NAV-BDSINFO (0x01 0x21)

INFORMATIONNAV-BDSINFO					
Describe BDS satellite information					
Type Cycle/Query					
information	head	length (bytes)	identifier	Payload Checksum	
structure	0xBA 0xCE	8+12*N	0x01 0x21 See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	-	Elapsed time to power-on/reset
4	U1	-	numViewSv	-	The number of visible satellites, the valid range is 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1	-	system	-	System type (refer to 2.7.7 Remarks [1])
7	U1	-	res		reserve
Start of repeating part (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	channel number
9+12*N	U1	-	svid	-	satellite number
10+12*N	U1	-	flags	-	Satellite status mask (refer to 2.7.7 Remarks [2])
11+12*N	U1	-	quality	-	Quality indication of signal measurement (refer to 2.7.7 Note [3])
12+12*N	U1	-	CN0	dB-Hz signal carrier to noise ratio	
13+12*N	I1	-	elev	°	Satellite elevation (-90~90)
14+12*N	I2	-	azim	°	Satellite Azimuth (0~360)
16+12*N	R4	-	prRes	m Pseudorange residuals	
end of repetition					

2.7.9 NAV-GLNINFO (0x01 0x22)

INFORMATIONNAV-GLNINFO					
Describe GLONASS satellite information					
Type Cycle/Query					
information	head	length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	8+12*N	0x01 0x22 See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	-	Elapsed time to power-on/reset
4	U1	-	numViewSv	-	The number of visible satellites, the valid range is 0~32
5	U1	-	numFixSv	-	Number of satellites used for positioning
6	U1	-	system	-	System type (refer to 2.7.7 Remarks [1])
	U1	-	res		reserve
7 Start of repeating part (N=numViewSv, valid range 0~32)					
8+12*N	U1	-	chn	-	channel number
9+12*N	U1	-	svid	-	satellite number
10+12*N	U1	-	flags	-	Satellite status mask (refer to 2.7.7 Remarks [2])
11+12*N	U1	-	quality	-	Quality indication of signal measurement (refer to 2.7.7 Note [3])
12+12*N	U1	-	CN0	dB-Hz signal carrier to noise ratio	
13+12*N	I1	-	elev	°	Satellite elevation (-90~90)
14+12*N	I2	-	azim	°	Satellite Azimuth (0~360)
16+12*N	R4	-	prRes	m Pseudorange residuals	
end of repetition					

2.7.10 NAV-IMUATT (0x01 0x06)

INFORMATIONNAV-IMUATT					
Describes the pose of the IMU coordinate system relative to the local navigation coordinate system (NED)					
Type Cycle/Query					
information	head		length (bytes) identifier		Payload Checksum
structure	0xBA 0xCE 32 payload			0x01 0x06	See table below 4 Bytes
content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	tow	s	When the receiver GPS is within the week (Note [1])
4	U2	-	weekNum	week	Receiver GPS week number (Note [1])
6	U1		flag	-	Attitude available flag (Note [2])
7	U1	-	res	-	reserve
8	I4	1e-5 rolls		deg roll angle	
12	I4	1e-5 pitch 1e-5		deg pitch angle	
16	I4	heading 1e-5 rollAcc		deg heading angle	
20	U4			deg roll angle accuracy	
twenty four	U4	1e-5 pitchAcc deg pitch angle accuracy			
28	U4	1e-5 headingAcc deg heading angle accuracy			
Note[1]: When the receiver GPS is within the week					
rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.					
Remark[2]: Attitude available flag					
flag	0x01 - pose estimation is valid; 0xff pose estimation is invalid.				

2.8 TIM (0x02)

2.8.1 TIM-TP (0x02 0x00)

message name TIM-TP					
Describe timing pulse information					
Type Cycle/Query					
Notes					
information	head	length (bytes) identifier payload checksum			
structure	0xBA 0xCE	24 0x02 0x00 See the table below 4 Bytes			
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	runTime	ms Running time to power-on/reset	
4	R4	-	qErr	s	Time quantization error corresponding to the next time pulse
8	R8	-	tow	s	The time of week corresponding to the next time pulse
16	U2	-	wn	-	The number of weeks corresponding to the next time pulse
18	U1	-	refTime	-	Reference time (Note [1])
19	U1	-	utcValid	-	Valid flags (remarks [2])
20	U4	-	res	-	reserve
Remark[1]: Timing pulse reference time					
Value description					
B3:B0	0: GPS time source 1: BDS time source 2: GLN time source				
B7:B4	0: The time base is UTC 1: The time reference is GNSS (refer to the value of B3:B0 for the specific system)				
Remark[2]: UTC parameter valid flag					
Value description					
0 missing					
1	reserve				
2	Expired				
3	efficient				

2.9 RXM (0x03)

Measured value message.

2.9.1 RXM-MEASX (0x03 0x10)

InfoRXM-MEASX					
Describe pseudorange, carrier phase raw measurement information					
Type Cycle/Query					
Notes					
information	head	Length (bytes) Identifier	0x03	Payload Checksum	
structure	0xBA 0xCE	16+32*N	0x10 See table below	4 Bytes	
Payload content:					
character offset	data type	Proportion zoom	name	Unit description	
0	R8	-	rcvTow	s	When the receiver GPS is within the week (Note [1])
8	I2	-	wn	week receiver GPS week number	
10	I1	-	leapS	s	UTC leap second value (note [2])
11	U1	-	numMeas	-	Number of measured values, valid range 0~32
12	U1	-	recStat	-	Receiver Status (Note [3])
13	U1	-	res1		reserve
14	U1	-	res2	-	reserve
15 res3 Start of repeating part (N=numMeas,	U1	-		-	reserve
valid range 0~32)					
16+32*N	R8	-	prMes	m	Pseudorange measurement in meters, for Inter-frequency deviation of GLONASS, receiver This is compensated by the built-in correction table.
24+32*N	R8	-	cpMes	cycles	Carrier phase measurement (unit: cycle) (Note [4])
32+32*N	R4	-	doMes	Hz	Doppler measurement (unit: Hz), close to The satellite Doppler is positive.
36+32*N	U1	-	gnssid	-	System type. 0=GPS , 1=BDS , 2=GLONASS
37+32*N	U1	-	svid	-	satellite number
38+32*N	U1	-	res4	-	reserve
39+32*N	U1	-	freqid	-	frequency number (offset 8), only for GLONASS is valid. range of valid values [1,14], corresponding to frequency [-7,+6].
40+32*N	U2	-	locktime	ms carrier phase lock time, maximum 65535ms	
42+32*N	U1	-	cn0	dB-Hz carrier-to-noise ratio	
43+32*N	U1	-	res5	-	reserve
44+32*N	U1	-	res6	-	reserve
45+32*N	U1	-	res7	-	reserve

46+32*N	U1	-	trkStat res8	-	Satellite tracking status (Note [5])
47+32*N	U1	-		-	reserve
end of repetition					

Note[1]: When the receiver GPS is within the week	
rcvTow	The receiver time is aligned with the GPS time system as much as possible. Use receiver week time rcvTow, receive Machine week number week, leap second value leapS can convert time to other time systems. more about not Please refer to the RINEX3 documentation for information on the time system. When the receiver works in single GLONASS mode, Subtract the leap second value leapS directly from the receiver time to get UTC time without considering recStat Whether the flags in are valid.
Remark[2]: UTC leap second value	
leapS	The leap second value between GPS time and UTC time, which is the latest value known to the receiver. recStat A flag bit in indicates whether the value is valid.
Note[3]: Receiver status	
recStat Description	
BIT0	=1, indicating that leap second value leapS is valid (UTC correction parameter is valid).
BIT1	= 1, it means that the clock reset occurs, and the receiver time jumps by an integer number of milliseconds.
Remark[4]: Carrier phase measurement value	
cpMes	Initialize the initial integer ambiguity of the carrier phase with an approximation such that the carrier phase measurement Close to pseudorange measurements. The clock reset mechanism acts on both the pseudorange measurement and the carrier Wave phase measurement, compliant with RINEX3.
Note[5]: Satellite tracking status	
trkStat	illustrate
BIT0	=1, indicating that the pseudorange measurement value prMes is valid
BIT1	=1, indicating that the carrier phase measurement value cpMes is valid
BIT2	=1, indicating that the half-cycle ambiguity is valid (inverted PI correction is valid)
BIT3	=1, indicating that the half-cycle ambiguity is subtracted from the carrier phase measurement

2.9.2 RXM-SVPOS (0x03 0x11)

Information RXM-SVPOS					
Describe satellite position information					
Type Cycle/Query					
Notes					
information	head	length (bytes) identifier	payload	checksum	
structure	0xBA 0xCE	16+48*N	0x03 0x11 See table below	4 Bytes	
payload content:					
character offset	data type	Proportion zoom	name	Unit description	
0	R8	-	rcvTow	s	Receiver GPS week time (Note [1])
8	I2	-	wn	week	receiver GPS week number (Note[1])
10	U1	-	numMeas	-	Number of measured values, valid range 0~32
11	U1	-	res1	-	reserve
12 res2 Repeat part start (N=numMeas, valid				-	reserve
range 0~32)					
16+48*N	R8	-	x	m	satellite coordinates
24+48*N	R8	-	y	m	satellite coordinates
32+48*N	R8	-	z	m	satellite coordinates
40+48*N	R4	-	svdt	m	Satellite clock difference
44+48*N	R4	-	svdf	m/s	satellite frequency deviation
48+48*N	R4	-	tropDelay	m	Tropospheric delay
52+48*N	R4	-	ionoDelay svid	m	ionospheric delay
56+48*N	U1	-		-	satellite number
57+48*N	U1	-	glnFreqid	-	frequency number (offset 8), for GLONASS efficient
58+48*N	U1	-	gnssid	-	system type , 0=GPS , 1=BDS , 2=GLONASS
59+48*N	U1	-	res3	-	reserve
60+48*N	U4	-	res4	-	reserve
repeat part ends					
Note[1]: When the receiver GPS is within the week					
rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.					

2.9.3 RXM-SENSOR (0x03 0x07)

INFORMATIONRXM- SENSOR					
Describe sensor information					
Type Cycle/Query					
Notes					
information	head	length (bytes)	Identifier	Payload Checksum	
structure	0xBA 0xCE	16+16*N	0x03 0x11 See table below	4 Bytes	

Payload content:					
character offset	data type	Proportion zoom	name	Unit description	
0	R8	-	rcvTow	s Receiver GPS week time (Note [1])	
8	I2	-	wn	week receiver GPS week number (Note[1])	
10	I1	-	leapS	s	Leap second time in current GPS system
11	U1	-	numMeas	-	Number of measured values (Note [2])
12	U1	-	recStat	-	receiver status
13	U1	-	timeSrc	-	0-GPS time; 1-BDS time
14	U1	-	rcvrId	-	0
15	U1	-	res	-	reserve
Repeat part starts (N=numMeas, valid range: 1/2/5/10/25/50 several discrete values)					
16+16*N I2		1g/16384 accX 1g/16384		m/s/s Accelerometer X-axis measurement (Note[3])	
18+16*N I2		accY 1g/16384 accZ		m/s/s accelerometer Y-axis measurement	
20+16*N I2		250/32768 gyroX		m/s/s Accelerometer Z-axis measurement	
22+16*N I2		250/32768 gyroY		deg/s gyroscope X-axis measurement (Note[4])	
24+16*N I2		250/32768 gyroZ 1/326.8		deg/s gyroscope Y-axis measurement	
26+16*N I2		temp		deg/s gyroscope Z-axis measurement	
28+16*N I2				oC thermometer measurement	
30+16*N I2		-	res	-	reserve
end of repetition					

Note[1]: When the receiver GPS is within the week	
rcvTow/wn Refer to the meaning of rcvTow/wn in RXM-MEASX.	
Remark[2]: Measured value data	
numMeas	Configured by the CFG-MSG statement, numMeas is related to the rate in the CFG-MSG. CFG-MSG In the statement rate=0, the RXM_SENSOR statement does not output; rate is equal to 1/2/5/10/25/50 One of the discrete values with numMeas=rate group MEMS sampled data in each statement; no Then, numMeas =50. If the RXM_SENSOR statement is output, it is output once per second.
Remark[3]: Accelerometer	
acc	The accelerometer range is -2g~+2g.
Note[4]: Gyroscope	
gyro	The range of the gyroscope is -250deg/s~+250deg/s.

2.10 ACK (0x05)

ACK and NACK are used to reply to received CFG messages.

2.10.1 ACK-NACK (0x05 0x00)

Information ACK-NACK					
Description Response to information not received correctly					
type answer					
Notes					
information structure	head	Length (bytes) Identifier 0x05 0x00		Payload Checksum	
	0xBA 0xCE	4	See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U1	-	clsID	- Type of information not received correctly	
1	U1	-	msgID	- The number of the message was not received correctly	
2	U2	-	res	- reserve	

2.10.2 ACK-ACK (0x05 0x01)

Information ACK-ACK					
Describe the information received in response to the correct					
type answer					
Notes					
information structure	head	length (bytes) identifier payload checksum			
	0xBA 0xCE	4	0x05 0x01 See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U1	-	clsID	- Type of information received correctly	
1	U1	-	msgID	- Number of correctly received messages	
2	U2	-	res	- reserve	

2.11 CFG (0x06)

Configuration information, such as setting dynamic mode, baud rate, etc. When the effective length is 0, it means to query the configuration information, and the system will Output data with the same identifier.

2.11.1 CFG-PRT (0x06 0x00)

Message CFG-PRT					
Describe the working mode of query UART, including UART0, UART1 two statements, the last output of the current UART statement					
Type query					
Notes					
information	head	length (bytes)	identifier	Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x00	0	4 Bytes

Message CFG-PRT					
Description Sets the working mode of the UART					
Type setting/response to query					
Notes					
information		Length (bytes)	Identifier Payload Checksum		
structure	header 0xBA 0xCE	8	0x06 0x00 See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U1	-	portID	-	Port identifier number (0 and 1 for UART0 and UART1, 0xFF means the currently connected UART)
1	U1	-	protoMask -		Protocol control mask, each port can support several protocols at the same time discussion. Protocol is enabled when the corresponding bit is equal to 1 (Note [1])
2	U2	-	mode bit mask of UART operating mode (Note[2])	-	
4	U4	-	baudRate bps baud rate		

Remark[1]: Protocol Control Mask		
Bit description		
B0 1=Binary protocol input		
B1	1=Text protocol input	
B4	1 = binary protocol output	
B5	1=text protocol output	
Remark[2]: UART operating mode bit mask		
Bit value description		
[7:6]	00	5bits
	01	6bits
	10	7bits
	11	8bits
[11:9]	10x	no verification
	001	Odd parity

	000	even parity
	x1x	reserve
[13:12]	00	a stop bit
	01	1.5 stop bits
	10	two stop bits
	11	reserve

2.11.2 CFG-MSG (0x06 0x01)

Information	CFG-MSG				
Description	Query all information sending frequency				
Type	query				
Notes					
information structure	header 0xBA 0xCE	Length (bytes) 0	Identifier 0x06 0x01	Payload Checksum 0	4 Bytes

Information	CFG-MSG				
Description	Set the frequency of sending information				
Type	settings				
Notes					
information structure	header 0xBA 0xCE	Length (bytes) 4	Identifier 0x06 0x01 See table below 4 Bytes	Payload Checksum	

payload content

character offset	data type	Proportion zoom	name	Unit description
0	U1	-	clsID	- Information type
1	U1	-	msgID	- message number
2	U2	-	rate	- Information sending frequency (Note [1])

Remarks[1]: Information sending frequency

Numerical description	
0 does not output	
1	Every time you locate, output once
2	Position twice, output once
N	N times of positioning, output once; In particular, when clsID=0x03, msgID=0x07, rate indicates the configured RXM_SENSOR information Medium sensor output samples per second.
0xFFFF	Immediately output once and only once, which is equivalent to query output

2.11.3 CFG-RST (0x06 0x02)

Message Name	CFG-RST				
Describes restarting the receiver/clearing saved data structures					
Type settings					
Notes					
information structure	head	Length (bytes) Identifier 4 0x06 0x02		Payload Checksum	
	0xBA 0xCE	See table below 4 Bytes			

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U2	-	navBbrMask -		Clear battery-backed RAM. If a bit of the mask is set to 1, then clear the data represented by this bit (Note [1])
2	U1	-	resetMode	-	Reset method (Note [2])
3	U1	-	startMode	-	Startup method (Note [3])

Remark[1]: Clear field	
bit description	
B0 Ephemeris	
B1	almanac
B2	health information
B3	Ionospheric parameters
B4	receiver positioning information
B5	Clock drift (clock frequency offset)
B6	Crystal parameters
B7	UTC correction parameters
B8	RTC
B9	configuration information

Remark[2]: Reset method	
Numerical description	
0	Immediate hardware reset (via WATCHDOG)
1	Controlled software reset
2	Controlled software reset (GPS only)
4	Hardware reset after shutdown (via WATCHDOG)

Remark[3]: Startup method	
Numerical description	
0	Hot Start
1	warm start
2	Cold start
3	Factory boot

2.11.4 CFG-TP (0x06 0x03)

InfoCFG-TP					
Description Query time pulse parameters					
Type query					
Notes					
information	head	length (bytes) identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x03	0	4 Bytes

InfoCFG-TP					
Description Read/set time pulse parameters					
type read/set					
Notes					
information	head	length (bytes) identifier	payload checksum		
structure	0xBA 0xCE	16	0x06 0x03 See the table below 4 Bytes		

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	interval	us time interval between pulses (pulse period)	
4	U4	-	width	us pulse width	
8	U1	-	enable	-	Enable flag (Note [1])
9	U1	-	polar	- Pulse polarity configuration (Note [2])	
10	U1	-	timeRef	- Reference time (Note [3])	
11	U1	-	timeSource	-	Time source (Note [4])
12	R4	-	userDelay	s user time delay	

Remark[1]: Pulse enable flag	
Value description	
0	off pulse
1	enable pulse
2	Pulses are enabled and output continuously. Automatically maintain pulse update rate when unable to locate normally
3	Output pulses during normal positioning, and do not output pulses when the receiver cannot be positioned normally

Remark[2]: Pulse Polarity Configuration	
0 rising edge	
1	falling edge

Note[3]: Reference time	
0	UTC time
1	satellite time

Note[4]: Satellite time source	
Numerical description	
0 Force single GPS timing	
1	Mandatory single BDS timing
2	Mandatory single GLN timing
3	reserve

4	Main BDS, can automatically switch to other timing systems when BDS is unavailable
5	Main GPS, can automatically switch to other timing systems when GPS is not available
6	Main GLN, can automatically switch to other timing systems when GLN is unavailable
7	reserve
other	Automatic selection of timing system

2.11.5 CFG-RATE (0x06 0x04)

message name CFG-RATE					
Describe the query positioning time interval					
Type query					
Notes	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate will directly affect the power consumption, The faster the rate, the greater the burden on the CPU and communication				
information structure		length (bytes) identifier header		Payload Checksum	
	0xBA 0xCE	0	0x06 0x04	0	4 Bytes

message name CFG-RATE					
Description Set the positioning time interval					
Type settings					
Notes	The receiver supports different navigation rates (the default rate is one update per second). The navigation rate will directly affect the power consumption, The faster the rate, the greater the burden on the CPU and communication				
information structure	Header Length (bytes) Identifier Payload Checksum				
	0xBA 0xCE	4	0x06 0x04 See table below 4 Bytes		

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U2	-	interval	ms	time interval between targeting
2	U2	-	res	-	reserve

2.11.6 CFG-CFG (0x06 0x05)

Information CFG - CFG					
Describes clearing, saving and loading configuration information					
type command					
Notes					
information structure	head	length (bytes) identifier payload checksum			
	0xBA 0xCE	4 0x06 0x05 See the table below 4 Bytes			
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U2	-	mask	-	Mask of configuration information (Note [1])
2	U1	-	mode	- Operation mode for configuration information (Note [2])	
3	U1	-	res	- reserve	

Remark[1]: Configuration information mask	
Bit description	
B0	IO port configuration information (CFG-PRT)
B1	Message Configuration (CFG-MSG)
B2	INF message configuration (CFG-INF)
B3	Navigation configuration (CFG-RATE, CFG-TMODE)
B4	Time Pulse Configuration (CFG-TP)
B5	Group Delay (CFG-GROUP)

Remark[2]: Operation Mode	
Numerical value	describe
0	Clear permanent configuration
1	Save current configuration to permanent configuration
2	The permanent configuration is loaded into the current configuration

2.11.7 CFG-TMODE (0x06 0x06)

InfoCFG-TMODE					
Describe query timing mode					
Type query					
Notes					
information	head	length (bytes) identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x06	0	4 Bytes

InfoCFG-TMODE					
Description Read/Set Timing Mode					
type read/set					
Notes					
information	head	length (bytes) identifier payload checksum			
structure	0xBA 0xCE	40	0x06 0x06 See the table below 4 Bytes		

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	mode	-	Timing Mode (Note [1])
4	R8	-	fixedPosX	m	X coordinate in ECEF coordinate system
12	R8	-	fixedPosY	m	Y coordinate in ECEF coordinate system
20	R8	-	fixedPosZ	m	Z coordinate in ECEF coordinate system
28	R4	-	fixedPosVar	3D variance of m^2 positions	
32	U4	-	svinMinDur	s	When the timing mode is 1, the minimum measurement time interval
36	R4		svinVarLimit	m^2 When the timing mode is 1, the positioning error limit	

Note[1]: Timing mode	
Numerical description	
0	Autonomous positioning and timing
1	After autonomous positioning for a period of time to obtain the user's position with sufficient accuracy, it only uses all available satellites to calculate the user's position. User clock parameters for timing. In this mode, when the user's location is fixed, single-star timing can be achieved
2	The user inputs the current position, and only uses all available satellites to calculate the user's clock parameters for timing. In this mode can realize single-star timing

2.11.8 CFG-NAVX (0x06 0x07)

Message NameCFG-NAVX					
Description Query Navigation Engine Professional Configuration					
Type query					
Annotation query navigation related parameters					
information	head	length (bytes) identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x07	0	4 Bytes

Message NameCFG-NAVX					
Describe the Navigation Engine Professional Configuration					
Type settings					
Annotation configuration navigation related parameters					
information	head	length (bytes) identifier payload checksum			
structure	0xBA 0xCE 44 0x06 0x07	See table below 4 Bytes			

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	mask	-	parameter mask, only the corresponding bit mask is set to 1, parameter Settings are applied (Note [1])
4	U1	-	dyModel	-	Dynamic Mode (Note [2])
5	U1	-	fixMode	-	Positioning mode (Note [3])
6	U1	-	minSVs	-	Minimum number of satellites for positioning
	U1	-	maxSVs	-	Maximum number of satellites used for positioning
7 8	U1	-	minCNO	dB-Hz	Minimum satellite signal carrier-to-noise ratio for positioning
9	U1	-	res1	-	reserve
10	U1		iniFix3D		The initial positioning must be the 3D positioning flag (0/1)
11	I1	-	minElev	°	GNSS satellite minimum elevation angle for positioning
12	U1	-	drLimit	s	Maximum DR time without satellite signal
13	U1	-	navSystem	-	Navigation system enable flag (Note [4])
14	U2	-	wnRollOver	-	GPS week rollovers
16	R4	-	fixedAlt	m	Fixed height for 2D positioning
20	R4	-	fixedAltVar	m^2	Fixed height error in 2D positioning
twenty four	R4	-	pDop	-	Position DOP Max
28	R4	-	tDop	-	Time DOP Max
32	R4	-	pAcc	m^2	maximum position accuracy
36	R4	-	tAcc	m^2	maximum time precision
40	R4	-	staticHoldTh	m/s	hold still threshold

Remark[1]: parameter mask	
bit description	
B0	Apply dynamic mode settings
B1	Apply targeting mode settings
B2	Apply maximum/minimum number of navigation satellites setting
B3	Apply Minimum SNR setting

B4	reserve
B5	Apply initial positioning 3D settings
B6	Apply Minimum Elevation Setting
B7	Apply DR limit settings
B8	App Navigation System Enable
B9	Apply GPS week rollover settings
B10	Apply Altitude Assist
B11	Apply location DOP restrictions
B12	Apply Time DOP Limits
B13	Apply static hold settings
Remark[2]: Dynamic Mode	
Mode description	
0	Portable Mode
1 Still Mode	
2	walk mode
3	car mode
4	nautical mode
5	Airplane mode acceleration <1g
6	Airplane mode acceleration <2g
7	Airplane mode acceleration <4g
Remark[3]: Positioning mode	
Mode description	
0	reserve
1	2D positioning
2	3D positioning
3	2D/3D positioning automatic switching
Note[4]: Navigation system enable	
Bit description	
B0	1=GPS
B1	1=BDS
B2	1=GLONASS

2.11.9 CFG-GROUP (0x06 0x08)

Message name CFG-GROUP					
Describes the group delay for querying GLONASS					
Type query					
Notes					
information structure	head	length (bytes) identifier		Payload Checksum	
	0xBA 0xCE	0	0x06 0x08	0	4 Bytes

Message name CFG-GROUP					
Describe the group delay for configuring GLONASS					
Type settings					
Notes					
information structure	head	length (bytes) identifier	payload checksum		
	0xBA 0xCE	56	0x06 0x08 See the table below 4 Bytes		

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	R4[14]	-	groupDealy m		GLONASS Group delay corresponding to each frequency, It is represented by distance (group delay time multiplied by the speed of light) to distance)

2.11.10 CFG-INS (0x06 0x10)

message name CFG-INS					
Description Query INS installation mode					
Type query					
Notes					
information	head	length (bytes) identifier		Payload Checksum	
structure	0xBA 0xCE	0	0x06 0x10	0	4 Bytes

message name CFG-INS					
Description Configure INS installation mode					
Type settings					
Notes					
information	head	length (bytes) identifier payload checksum			
structure	0xBA 0xCE	4 0x06 0x10 See the table below 4 Bytes			

payload content

character offset	data type	Proportion zoom	name	Unit description	
0	U2	-	attMode	-	The mode of the module's relative installation attitude relative to the vehicle Configuration, the possible value range: 0, 1, 2, 3. 0: The module X axis points to the front of the vehicle. 1: The module X-axis points to the right of the vehicle. 2: The module X-axis points to the rear of the vehicle. 3: The module X-axis points to the left of the vehicle. 9: Adaptive estimation module relative pose. The default is 9.1: the
2	U2		ramStart	-	dead reckoning function is enabled immediately after the backup power is powered on. start 0: The dead reckoning function is disabled immediately after the backup power is powered on. close Off by default

2.12 MSG (0x08)

Receiver navigation message, message class is 0x08.

2.12.1 MSG-BDSUTC (0x08 0x00)

Information MSG-BDSUTC					
Describes BDS fixed-point UTC data (parameters for synchronization with UTC time)					
type cycle					
Notes					
information structure	head	length (bytes) identifier		Payload Checksum	
	0xBA 0xCE 20		0x08 0x00	See table below 4	Bytes
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	res1	- reserve	
4	I4	2^{-30}	a0UTC	s	Clock offset of BDT relative to UTC
8	I4	2^{-50}	a1UTC	s/s	Clock speed of BDT relative to UTC
12	I1	-	dtls	s	The cumulative leap second change of BDT relative to UTC before the new leap second takes effect. Positive number
13	I1	-	dtlsf	s	After the new leap second takes effect, the cumulative leap second change of BDT relative to UTC Positive number
14	U1	-	res2	- reserve	
15	U1	-	res3	- reserve	
16	U1	-	wnlsf	week	The week count for which the new leap second takes effect
17	U1	-	dn	day	day count of the week for which the new leap second is in effect
18	U1	-	valid	-	Information available flag (Note [1])
19	U1	-	res4	- reserve	

Remark[1]: Information available flag	
Numerical description	
0 is invalid	
1	unhealthy
2	Expired
3	efficient

2.12.2 MSG-BDSION (0x08 0x01)

Information MSG-BDSION					
Describing BDS8 Parametric Fixed-Site Ionospheric Data					
type cycle					
Notes					
information structure	head	length (bytes) identifier			Payload Checksum
	0xBA 0xCE	16	0x08 0x01		See table below 4 Bytes

payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	res1	-	reserve
4	I1	2^{-30}	alpha0	s Ionospheric parameters	
5	I1	2^{-27}	alpha1	$\frac{s}{\pi}$	Ionospheric parameters
6	I1	$2^{\text{Identity filter}}$	alpha2	$\frac{s}{\pi^2}$	Ionospheric parameters
7	I1	$2^{\text{Identity filter}}$	alpha3	$\frac{s}{\pi^3}$	Ionospheric parameters
8	I1	2^{11}	beta0	s Ionospheric parameters	
9	I1	2^{14}	beta1	$\frac{s}{\pi}$	Ionospheric parameters
10	I1	2^{16}	beta2	$\frac{s}{\pi^2}$	Ionospheric parameters
11	I1	2^{16}	beta3	$\frac{s}{\pi^3}$	Ionospheric parameters
12	U1	-	valid	-	Information available flag (Note [1])
13	U1	-	res2	-	reserve
14	U2	-	res3	-	reserve

Remark[1]: Information available flag	
Numerical description	
0 is invalid	
1	unhealthy
2	Expired
3	efficient

2.12.3 MSG-BDSEPH (0x08 0x02)

Information MSG-BDSEPH					
Describing BDS Ephemeris					
type cycle					
Notes					
information structure	head	length (bytes) identifier		Payload Checksum	
	0xBA 0xCE	92	0x08 0x02 See the table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name unit description		
0	U4	-	res1	-	reserve
4	U4	2^{-19}	sqra	square root of the semi-major axis of m1/2 satellite orbit	
8	U4	2^{-33}	es	-	satellite orbit eccentricity
12	I4	2^{-31}	ω	π	argument of perigee
16	I4	2^{-31}	M0	π	Perimeter angle of reference time
20	I4	2^{-31}	i0	π	Orbital inclination at reference time
twenty four	I4	2^{-31}	Ω_0	π	Ascending node right ascension by reference time
28	I4	2^{-43}	$\dot{\Omega}$	$\frac{\pi}{s}$	Ascending node right ascension rate of change
32	I2	2^{-43}	Δn	$\frac{\pi}{s}$	The difference between the average speed of the satellite and the calculated value
34	I2	2^{-43}	IDOT	$\frac{\pi}{s}$	Orbital Inclination Rate of Change
36	I4	2^{-31}	cuc	rad cosine harmonic correction term amplitude of latitude argument	
40	I4	2^{-31}	cus	rad Sine harmonic correction term amplitude of latitude argument	
44	I4	2^{-6}	crc	m cosine harmonic correction term amplitude of orbital radius	
48	I4	2^{-6}	crs	m Sine harmonic correction term amplitude for orbital radius	
52	I4	2^{-31}	cic	rad cosine harmonic correction term amplitude for orbital inclination	
56	I4	2^{-31}	cis	rad Sine harmonic correction term amplitude for orbital inclination	
60	U4	2^{3}	toe	s	Ephemeris reference time
64	U2	-	wne	-	whole week number of reference time
66	U2	-	res2	-	reserve
68	U4	2^{3}	toc	s	Reference time of clock difference parameters in this period
72	I4	2^{-33}	af0	s	Satellite Ranging Code Phase Time Offset Coefficient
76	I4	2^{-50}	af1	s/s Satellite Ranging Code Phase Time Offset Coefficient	
80	I2	2^{-66}	af2	s/s 2 Satellite ranging code phase time offset coefficient	
82	I2	0.1	tgd	ns on-board equipment delay difference	
84	U1	-	iodc	-	clock data age
85	U1	-	iode	-	Ephemeris data age
86	U1	-	ura	-	User distance accuracy
87	U1	-	health	-	Satellite autonomous health label
88	U1	-	svid	-	satellite number
89	U1	-	valid	-	Information available flag (remarks [1])

90	U2	-	res3	-	reserve
Remark[1]: Information available flag					
Numerical description					
0 is invalid					
1 unhealthy					
2 expired					
3 valid					

2.12.4 MSG-GPSUTC (0x08 0x05)

Information MSG-GPSUTC					
Describes GPS fixed-point UTC data (synchronized with UTC time parameters)					
type cycle					
Notes					
information structure	head	Length (bytes) Identifier 0x08 0x05		Payload Checksum	
	0xBA 0xCE	20	See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	res1	-	reserve
4	I4	2^{-30}	a0UTC	s	GPST clock offset from UTC
8	I4	2^{-50}	a1UTC	s/s	GPST clock speed relative to UTC
12	I1	-	dtls	s	Accumulation of BDT relative to UTC before the new leap second takes effect Leap second correction
13	I1	-	dtlsf	s	After the new leap second takes effect, the cumulative BDT relative to UTC Leap second correction
14	U1	2^{12}	tot	s	Reference time for UTC data
15	U1	-	wnt	week	UTC reference week number
16	U1	-	wnlsf	week	count of the week in which the new leap second is in effect
17	U1	-	dn	day	count of the day of the week for which the new leap second is in effect
18	U1	-	valid	-	Information available flag (remarks [1])
19	U1	-	res2	-	reserve
Remark[1]: Information available flag					
The value 0 is invalid	illustrate				
1	unhealthy				
2	Expired				
3	efficient				

2.12.5 MSG-GPSION (0x08 0x06)

Information MSG-GPSION					
Describing GPS ionospheric data					
type cycle					
Notes					
information structure	head	Length (bytes) Identifier 0x08 0x06		Payload Checksum	
	0xBA 0xCE	16	See table below 4 Bytes		
payload content					
character offset	data type	Proportion zoom	name	unit	describe
0	U4	-	res1	-	reserve
4	I1	2^{-30}	alpha0	s	Ionospheric parameters
5	I1	2^{-27}	alpha1	$\frac{s}{\pi}$	Ionospheric parameters
6	I1	2 twenty four	alpha2	$\frac{s}{\pi^2}$	Ionospheric parameters
7	I1	2 twenty four	alpha3	$\frac{s}{\pi^3}$	Ionospheric parameters
8	I1	2^{11}	beta0	s	Ionospheric parameters
9	I1	2^{14}	beta1	$\frac{s}{\pi}$	Ionospheric parameters
10	I1	2^{16}	beta2	$\frac{s}{\pi^2}$	Ionospheric parameters
11	I1	2^{16}	beta3	$\frac{s}{\pi^3}$	Ionospheric parameters
12	U1	-	valid	-	Information available flag (remarks [1])
13	U1	-	res2	-	reserve
14	U2	-	res3	-	reserve

Remark[1]: Information available flag	
Numerical description	
0 is invalid	
1	unhealthy
2	Expired
3	efficient

2.12.6 MSG-GPSEPH (0x08 0x07)

INFORXM-GPSEPH					
Describe GPS Ephemeris					
type cycle					
Notes					
information structure	head	Length (bytes) Identifier 0x08		Payload Checksum	
	0xBA 0xCE	72	0x07 See table below	4 Bytes	
payload content					
character offset	data type	Proportion zoom	name unit description		
0	U4	-	res1	-	reserve
4	U4	2^{-19}	sqra	square root of the semi-major axis of m1/2 satellite orbit	
8	U4	2^{-33}	es	-	satellite orbit eccentricity
12	I4	2^{-31}	ω	π	argument of perigee
16	I4	2^{-31}	M0	π	Perimeter angle of reference time
20	I4	2^{-31}	i0	π	Orbital inclination at reference time
twenty four	I4	2^{-31}	Ω_0	π	Ascending node right ascension by reference time
28	I4	2^{-43}	$\dot{\Omega}$	$\frac{\pi}{s}$	Ascending node right ascension rate of change
32	I2	2^{-43}	Δn	$\frac{\pi}{s}$	The difference between the average speed of the satellite and the calculated value
34	I2	2^{-43}	IDOT	$\frac{\pi}{s}$	Orbital Inclination Rate of Change
36	I2	2^{-29}	cuc rad cosine harmonic correction term amplitude of latitude argument		
38	I2	2^{-29}	cus	rad Sine harmonic correction term amplitude of latitude argument	
40	I2	2^{-5}	crc	m cosine harmonic correction term amplitude of orbital radius	
42	I2	2^{-5}	crs	m Sine harmonic correction term amplitude for orbital radius	
44	I2	2^{-29}	cic	rad cosine harmonic correction term amplitude for orbital inclination	
46	I2	2^{-29}	cis	rad Sine harmonic correction term amplitude for orbital inclination	
48	U2	2^{4}	toe	s	Ephemeris reference time
50	U2	-	wne -		whole week number of reference time
52	U4	2^{4}	toc	s	Reference time of clock difference parameters in this period
56	I4	2^{-31}	af0	s	Satellite Ranging Code Phase Time Offset Coefficient
60	I2	2^{-43}	af1	s/s Satellite Ranging Code Phase Time Offset Coefficient	
62	I1	2^{-55}	af2	s/s 2 Satellite ranging code phase time offset coefficient	
63	I1	2^{-31}	tgd	s	Onboard equipment delay difference
64	U2	-	iodc -		clock data age
66	U1	-	ura	-	User distance accuracy
67	U1	-	health -		Satellite autonomous health label
68	U1	-	svid	-	satellite number
69	U1	-	valid	-	Information available flag (remarks [1])
70	U2	-	res2	-	reserve
Remark[1]: Information available flag					

value	illustrate
0	invalid
1	unhealthy
2	Expired
3	efficient

2.12.7 MSG-GLNEPH (0x08 0x08)

INFORMATIONRXM-GLNEPH					
Describing GLONASS Ephemeris					
type cycle					
Notes					
information	head		length (bytes)	Identifier Payload Checksum	
structure	0xBA 0xCE		68	0x08 0x08 see the table below 4 Bytes	
payload content					
character offset	data type	Proportion zoom	name unit description		
0	U4	-	res1	-	reserve
4	I4	2^{-30}	taon	s	Correction of nth satellite relative to GLONASS time
8	I4	2^{-11}	x	km	Satellite position coordinates in PZ-90 coordinate system
12	I4	-11 2	y	km	Satellite position coordinates in PZ-90 coordinate system
16	I4	2^{-11}	z	km	Satellite position coordinates in PZ-90 coordinate system
20	I4	2^{-20}	dx	Satellite velocity in km/s PZ-90 coordinate system	
twenty four	I4	2^{-20}	dy	Satellite velocity in km/s PZ-90 coordinate system	
28	I4	2^{-20}	dz	Satellite velocity in km/s PZ-90 coordinate system	
32	I4	2^{-31}	taoc	s	GLONASS time relative to UTC time scale correction amount
36	I4	2^{-30}	taoGPS day Correction amount from GLONASS time to GPS time		
40	I2	2^{-40}	gamman -		Relative deviation of satellite predicted carrier frequency
42	U2	-	tk	-	The time of day in the current frame, a total of 12 bits
44	U2	-	nt	day The current day since January of the last leap year	
46	I1	2^{-30}	ddx	km/s ^{2}	Satellite acceleration in PZ-90 coordinate system
47	I1	2^{-30}	ddy	km/s ^{2}	Satellite acceleration in PZ-90 coordinate system
48	I1	2^{-30}	ddz	km/s ^{2}	Satellite acceleration in PZ-90 coordinate system
49	I1	2^{-30}	dtaon	s	The propagation time difference between the L2 signal and the L1 signal of the nth satellite
50	U1	-	bn	-	health sign
51	U1	900	tb	s Intraday time of the current moment (in UTC+3)	
52	U1	-	M	-	GLONASS satellite category
53	U1	-	P	- Control part of technical parameters	
54	U1	-	ft	-	Prediction Accuracy of Satellite Pseudoranges
55	U1	-	en	day satellite ephemeris age	
56	U1	-	p1	-	Ephemeris information update time flag
57	U1	-	p2	-	tb parity bit

58	U1	-	p3	-	The almanac passed in the current frame contains the number of satellites
59	U1	-	p4	-	Ephemeris data update flag: 1 is updated
60	U1	-	ln	-	Satellite Health Mark (GLONASS-M satellites)
61	U1	-	n4	-	Time counting (starting in 1996, in four-year cycles)
62	U1	-	svid	-	satellite number
63	U1	-	nl	-	frequency number
64	U1	-	valid	-	Information available flag (remarks [1])
65	U1	-	res2	-	reserve
66	U2	-	res3	-	reserve

Remark[1]: Information available flag

Numerical description	
0	invalid
1	unhealthy
2	Expired
3	efficient

2.13 MON (0x0A)

Monitoring information, such as configuration status, task status, etc.

2.13.1 MON-VER (0x0A 0x04)

Information MON-VER					
Description version information					
type response query					
Notes					
information structure	head	Length (bytes) Identifier 0x0A		Payload Checksum	
	0xBA 0xCE	64	0x04 See table below	4 Bytes	
Payload content:					
character offset	data type	Proportion zoom	name	Unit description	
0	CH[32] -		swVersion	- Software version string	
32	CH[32] -		hwVersion	- Hardware version string	

2.13.2 MON-HW (0x0A 0x09)

Information MON-HW					
describe the hardware state					
Type Cycle/Query					
Annotate various configuration states of hardware, including antenna status, IO port status, noise level, AGC information, etc.					
information structure	head	length (bytes) identifier		Payload Checksum	
	0xBA 0xCE	56	0x0A 0x09 See table below 4 Bytes		
payload content:					
character offset	data type	Proportion zoom	name	Unit description	
0	U4	-	noisePerMs0	-	Noise power of DIF0 IF data
4	U4	-	noisePerMs1	-	Noise power of DIF1 IF data
8	U4	-	noisePerMs2	-	Noise power of DIF2 IF data
12	U2	-	agcData0	-	DIF0 The number of 1's for the amplitude bits of the IF data
14	U2	-	agcData1	-	DIF1 Number of 1's for the amplitude bits of the IF data
16	U2	-	agcData2	-	DIF2 Number of 1's for the amplitude bits of the IF data
18	U2	-	res	- reserve	
20	U1	-	antStatus	-	Antenna Status (Note [1])
twenty one	U1	-	res	- reserve	
twenty two	U1	-	res	- reserve	
23	U1	-	res	- reserve	
24	U4[8] 2^24 jamming Remarks[1]:			- Center frequency of the interfering signal (normalized)	
Antenna status					
Numerical description					
0	initialization process				
1	Unknown status				
2	normal				
3	short circuit				
4	open circuit				

2.14 AID (0x0B)

Auxiliary information, such as receiver initial position, time, etc.

2.14.1 AID-INI (0x0B 0x01)

Information	AID-INI				
Describe auxiliary position, time, frequency, clock offset information					
Type query/input					
Annotation configuration navigation related parameters					
information structure	head	length (bytes) identifier payload checksum			
	0xBA 0xCE 56 0x0B 0x01	See table below 4 Bytes			

payload content					
character offset	data type	Proportion zoom	name	unit	describe
0	R8	-	ecefXOrLat m or 1°		X coordinate or latitude in ECEF coordinate system: If it is an ECEF coordinate system, the unit is m; In the case of latitude, the unit is degrees.
8	R8	-	ecefYOrLon m or 1°		Y coordinate or longitude in ECEF coordinate system: If it is an ECEF coordinate system, the unit is m; If it is longitude, the unit is degrees.
16	R8	-	ecefZOrAlt m		Y coordinate or height in ECEF coordinate system
twenty four	R8	-	tow	s	GPS time of week
32	R4	300	freqBias	ppm	clock frequency drift. Example: FreqBias=300, indicating the frequency offset of the crystal oscillator 1ppm; FreqBias=-150, indicates the frequency offset of the crystal oscillator -0.5ppm;
36	R4	-	pAcc	m^2	Variance of estimation error for 3D position
40	R4 C^2 tAcc			s^2	The variance of the estimation error over time. Example: tAcc=9，indicating that the time error is sqrt(tAcc)/C=3/3e8=10ns
44	R4	300^2 fAcc		ppm^2	The variance of the clock frequency drift error. Example: fAcc=900，which means that the time error is sqrt(fAcc)/300=30/300=0.1ppm
48	U4	-	res	-	reserve
52	U2	-	wn	-	GPS week number
54	U1	-	timeSource	-	time source
55	U1	-	flags	-	Flag mask (remarks[1])

Remark[1]: Flag mask	
Bit description	
B0	1=Position is valid
B1	1=Time is valid
B2	1=Clock frequency drift data is valid

B3	reserve
B4	1=Clock frequency data is valid
B5	1=Location is in LLA format
B6	1=Invalid height
B7	reserve

2.14.2 AID-HUI (0x0B 0x03)

Information AID-HUI					
Describe supplementary health information, UTC parameters, ionospheric parameters					
Type input					
Annotation configuration navigation related parameters					
structure		header 0xBA 0xCE	length (bytes) identifier message 60 0x0B 0x03 See the table below 4 Bytes	Payload Checksum	
payload content					
character offset	data type	Proportion zoom	name	Unit description	
4	U4	-	HeaGps	-	Health information of GPS satellites (Note [1])
8	U4	-	HeaBds	-	Health information of BDS satellites (Note [1])
12	U4	-	HeaGln	-	Health information of GLONASS satellites (Note [1])
16	I4	2^{-30}	utcGpsA0 s utcGpsA1		UTC parameter A0, the clock offset of GPS time relative to UTC
20	I4	2^{-50}	s/ss New skip second		UTC parameter A1, clock speed of GPS time relative to UTC
twenty four	I1	-	utcGpsLS	GPS time skip seconds relative to UTC	
25	I1	-	utcGpsLSF s New skip seconds GPS time relative to UTC skip seconds		
26	U1	-	utcGpsTow s		Reference time of week for the UTC parameter of GPS
27	U1	-	utcGpsWNT week The reference week number for the UTC parameter of the GPS		
28	U1	-	utcGpsWNF week GPS week number in which the new jump seconds are valid		
29	U1	-	utcGpSDN-day		Days of the week for which the GPS new jumping seconds are in effect
30	I2	-	Res reserved	-	
32	I4	2^{-30}	utcBdsA0	s	UTC parameter A0, the clock offset of BDS time relative to UTC
36	I4	2^{-50}	utcBdsA1	s/	UTC parameter A1, the clock speed of BDS time relative to UTC
40	I1	-	utcBdsLS	ss New jump seconds before BDS jump seconds relative to UTC	
41	I1	-	utcBdsLSF	s The jump second relative to UTC in BDS time after the new jump second	
42	U1	-	utcBdsTow s		Reference time of week for the UTC parameter of the BDS
43	U1	-	utcBdsWNT week The reference week number for the UTC parameter of the BDS		
44	U1	-	utcBdsWNF week BDS week number for the new jump seconds to take effect		
45	U1	-	utcBdsDN BDS The number of days in the week for which the new jump seconds will take effect day		
46	I2	-	Res	-	reserve
48	I1	2^{-30}	klobA0	s/ÿ	Klobuchar model parameter alpha0
49	I1	2^{-27}	klobA1	s/ÿ ^{1}	Klobuchar model parameter alpha1
50	I1	$2^{\text{twenty four}}$	klobA2	s/ÿ ^{2}	Klobuchar model parameter alpha2
51	I1	2^{-24}	klobA3	s/ÿ ^{3}	Klobuchar model parameter alpha3
52	I1	2^{11}	klobB0	s/ÿ	Klobuchar model parameter beta0
53	I1	2^{14}	klobB1	s/ÿ ^{1}	Klobuchar model parameter beta1
54	I1	2^{16}	klobB2	s/ÿ ^{2}	Klobuchar model parameter beta2
55	I1	16 2	klobB3	s/ÿ ^{3}	Klobuchar model parameter beta3
56	U4	-	flags	-	mask of valid flags (remarks[2])
Remark [1]: B0 represents the No. 1 satellite, and so on, the corresponding bit is equal to 0, which means the satellite is healthy.					
Remark[2]: Valid flag					
Bit description					

B0	health information is valid
B1	UTC parameters are valid
B2	Ionospheric parameters are valid